Growth, skills and innovation in the Tasmanian industrial structure: key changes over time and potential for future growth

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1. Background

Understanding the composition of the Tasmanian economy is essential for many aspects of public policy at local, state and federal levels. Employment, skills, infrastructure, migration, and community needs are all tied in to the current and future structure of Tasmanian industries. Industry innovation and productivity levels are key factors for determining the competitiveness, growth and future shape the Tasmanian industrial structure. However, data on the Tasmanian economy is often limited in detail, and particularly in relation to innovation and productivity.

Since emerging in the early 1990's, standardised innovation surveys of firm level innovation activity have generated a new source of economic statistics that can assist with industry level economic analysis. To date there has been little work using these statistics in Australia, and particularly in relation to mainstream economic indicators. New data from the Tasmanian Innovation Census can assist with economic analysis for Tasmania.

The main aim of this paper is to firstly present a descriptive picture of the composition of the Tasmanian industrial structure over time, bringing together available data sources on output, exports, employment, occupations and qualifications, and seeking to identify deep capabilities relevant to potential future growth, skills and employment needs. Secondly, the intention is to use data from the Tasmanian Innovation Census to broadly profile industry innovation characteristics against the backdrop of structural change at the industry level, and to provide a basis for guiding further study to understand the links between innovation and economic performance.

2. Introduction

The main approach of this paper is to provide a descriptive picture of the Tasmanian economy and key changes in the industrial structure over time, focusing on larger and faster growing sectors, and mapping the characteristics of change across industry in employment, output, occupations, qualifications, and productivity. The paper then considers industries with potential for future growth based on areas of revealed capability and innovation.

The paper draws on ABS data as well as data from the 2007 AIRC Tasmania Innovation Census (TIC). The paper is structured in two main sections: the first overviews historic structure and change across the Tasmanian economy and the second section considers indicators for future growth in terms of industry capabilities and innovation characteristics.

3. Review of the Tasmanian industrial structure and key changes over time

This section of the paper reviews the industrial structure of the Tasmanian economy and key structural shifts over the past twenty years. The objective is firstly to identify at a broad level the largest industry sectors by contribution to economic output and

employment, and secondly to observe key structural changes and sectors exhibiting the most growth in output over time.

It is important at the outset to demarcate between public and private sector elements in the economy. ABS data on output and employment includes both public and private elements across all industry categories, and though it is not possible to differentiate between elements at the sector level, we can make some assumptions based on the general structure of the ANZSIC industry classification. The ANZSIC divisions public administration and safety, health care and social assistance, and education and training mostly consist of public sector elements. Consequently, in the ensuing discussion of output and employment (based on ABS data) these ANZSIC divisions are assumed to represent the public sector. However data from the Tasmanian Innovation Census (TIC) applies only to the private sector economy in Tasmania, so any discussion of these sectors based on TIC data applies only to the private sector elements of these ANZSIC divisions.

3.1 Structure and change in output across the Tasmanian industrial structure

Table 1. Structure of the Tasmanian and Australian economies, 2006.

Industry sector	Tasmania		Australia	
	Industry share of total gross value added	Industry share of total employment	Industry share of total gross value added	Industry share of total employment
Public administration and safety, health and education	22.0%	28.1%	16.3%	24.9%
Utilities construction, and transport	16.5%	12.7%	14.9%	13.5%
Knowledge intensive business services	16.3%	12.7%	25.4%	17.2%
Manufacturing	14.2%	10.3%	10.8%	10.5%
Retail trade, wholesale trade, accommodation and food services	12.0%	22.5%	12.2%	22.0%
Agriculture, forestry & fishing	6.4%	5.6%	3.0%	3.1%
Arts and recreation services, other services	3.2%	4.9%	3.0%	5.1%
Mining	2.1%	0.8%	7.2%	1.2%

Source: ABS cat 2068.0, 2006, ABS cat 5204.0, 2009. ABS cat 5220.0, 2009. Shares in GVA at current prices. Output figures are from August 2006 for comparability with employment.
Industry categories aggregate ANZSIC divisions as follows:
Public administration and safety, health and education: O,P,Q
Utilities, construction and transport: ANZSIC Divisions D, E, I,
Retail trade, wholesale trade, accommodation and food services : ANZSIC Divisions F, G ,H
Knowledge intensive business services: ANZSIC Divisions J, K, L, M, N
Arts and recreation services, other services : ANZSIC Divisions R, S

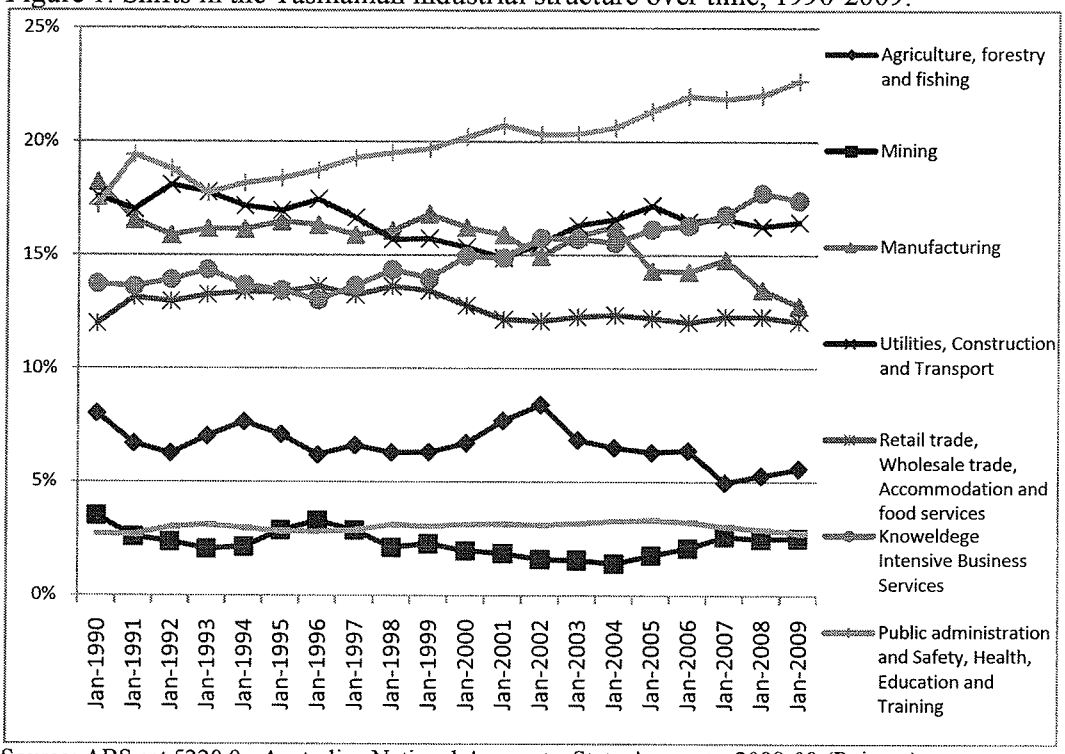
Table 1 presents a *snapshot* of the Tasmanian and Australian economies, showing the distribution of industry shares in total Gross Value Added (GVA) and employment in Tasmania compared with the national distribution. In Tasmania, public administration and safety, health and education sectors are the largest, contributing to 21.8% of GVA and 28.1% of total employment. Utilities, construction and transport, and Knowledge Intensive Business Services (KIBS) are the second largest contributors to GVA and

employment each with relatively equal contributions to both. Retail trade, wholesale trade, accommodation and food services account for the second largest share of employment (22.5%).

The Tasmanian economy has some distinctive structural differences compared with the national structure (excluding public sector elements): in terms of value added manufacturing is larger and mining is smaller, while agriculture, forestry and fishing are relatively larger in both value added and employment and KIBS notably smaller. Tasmania shares similarities with the national structure and many advanced OECD economies insofar as services now account for around 70% of output[1].

Figure 1 provides a picture of the changing shape of the economy over time, showing the distribution of industry contributions to total GVA over the past twenty years to the most current period (for available data to 2009)[2].

Figure 1. Shifts in the Tasmanian industrial structure over time, 1990-2009.



Source: ABS cat 5220.0 - Australian National Accounts: State Accounts, 2008-09 (Reissue)

From 1990 to 2009, three major structural trends are evident in the industry distribution of total value added: an increase in the relative share of public administration and safety, health and education (from 17.2% of total GVA to 22.7%) and knowledge intensive business services (from 13.7% of total GVA to 17.4%), and

[1] Based on a definition of services that includes all ANZSIC divisions apart from agriculture, forestry and fishing, mining and manufacturing.

[2] Shows the relative industry shares in total industry GVA, at current prices for each year. This provides a measure of industry contribution to economic output in a given year. Total industry GVA excludes value for taxes less subsides. Referenced figures differ from Table 1 as they include more recent data from ABS cat 5220.0.

a decrease in manufacturing (21.8% to 11.4%)[3]. Apart from these changes the industrial structure appears relatively stable. Further disaggregation of industry categories reveals key changes within the larger service sectors[4]:

Within public administration and safety, health and education;

- Health care and social assistance increased its relative share of total GVA from 6.3% to 9.4%, and is now the largest contributor, while public administration and safety and education and training each showed smaller increases of around 1% of GVA.

Within knowledge intensive business services;

- Finance and insurance services is the largest sector and has exhibited the most growth, increasing its share of total GVA from 5.1% to 9.5% over the period.
- Over the past decade Information media and telecommunications relative share of total GVA has decreased by just under 2%.

Within utilities, construction and transport

- Following a relative decline in the 1990's Transport, postal and warehousing has increased its relative share of total GVA by around 2% over the past decade.
- As a cyclical sector, construction has followed broader negative swings in the economy with volatility over time, and has increased its share in total GVA by just under 2% over the past decade.

In addition to shifts in industry shares of total value added over time, we can identify faster growing sectors in absolute terms, as the magnitude and rate of individual sector growth can be obscured in relative terms as concurrent changes occur across the economy. Table 2 shows selected sectors with annual growth rates notably higher than average over the period[5].

[3] Total value added is the sum of individual industry value added, in current prices, based on ABS cat 5220.0.

[4] Disaggregation by ANZSIC division is included in Appendix A.

[5] High growth here is defined by difference from the average growth rate for all industries – approximately double the growth rate for all industries.

Table 2. Average industry growth rate, 1990-2009.

Industry	Average annual growth 1990-2009 Tas (%)	Average annual growth 1990-2009 Aus (%)	Industry % Total industry GVA 2009 (Tas)	GVA $M 2009 (Tas)
Agriculture, forestry and fishing	9.0	3.3	5.7%	1183
KIBS				
Information media and telecommunications	6.8	6.4	2.1%	427
Administrative and support services	5.3	5.1	1.5%	299
Professional, scientific and technical services	4.8	5.3	2.6%	530
Health care and social assistance	4.1	4.1	9.0%	1864
Transport, postal and warehousing	4.0	3.9	6.7%	1384
All industries	**2.1**	**3.2**		**20607**

Source: ABS cat 5220.0. Calculated from annual growth rates using chain volume measures.

Over the past twenty years agriculture, forestry and fishing has shown the highest average annual growth rate. In KIBS, information media and telecommunications, administrative and support services, and professional, scientific and technical services all exhibited growth rates substantially higher than the average. These are followed by health care and social assistance and transport, postal and warehousing. There is a large and growing literature on the importance of KIBS to innovation, growth and competitiveness in the OECD economies and these sectors, though relatively small in Tasmania, have exhibited high output growth over the past two decades.

3.2 Exports in Tasmania

As a regional economy Tasmania has been traditionally more reliant on export income, with around half of the states goods and services sold to interstate and overseas markets (Felton, 2006). In 2008-2009 international exports represented 16.9% of GSP and imports 5.7%[6]. Japan, Korea, Hong Kong, Taiwan, China, and the United States were the major export destinations, accounting for over 50% of the total value of overseas exports in 2008-2009[7].

[6] Based on figures in ABS cat 5220.0, 2009.

[7] The value of overseas exports is likely to be greater than reflected in official statistics, as many overseas bound goods are first exported interstate and recorded as exports from the state of final departure.

Table 3. Tasmanian exports by broad category, 2008-2009 ($A million)

						% growth	
	2004-05	2005-06	2006-07	2007-08	2008-09	2007-08 to 2008-09	5 year trend
Merchandise (a)							
Total primary products	**903**	**1,238**	**1,356**	**1,450**	**1,521**	***4.9***	***18.0***
Unprocessed food	158	162	188	190	233	*22.6*	*8.9*
Processed food	332	307	322	303	323	*6.6*	*1.6*
Fuels	1	0	0	0	0	..	..
Minerals	262	362	378	472	546	*15.7*	*27.3*
Other primary	151	406	469	485	418	*-13.8*	*41.8*
Total manufactures	**937**	**1,286**	**1,832**	**1,445**	**1,218**	***-15.7***	***9.3***
STM (excl nickel)	836	1,144	1,650	1,251	1,043	*-16.6*	*9.7*
ETM	101	142	182	194	175	*-9.8*	*7.8*
Other	**799**	**369**	**525**	**740**	**742**	***0.3***	***-0.1***
Total merchandise exports	**2,639**	**2,893**	**3,713**	**3,635**	**3,480**	***-4.3***	***9.7***
Services (b)							
Manufacturing services	na	na	na	na	na	..	..
Maintenance & repair	0	0	5	0	0	..	..
Transport	38	35	40	58	35	*-39.7*	*2.1*
Travel	285	333	350	368	362	*-1.6*	*8.9*
Other	15	17	21	17	25	*47.1*	*5.8*
Total services exports	**338**	**385**	**416**	**443**	**422**	***-4.7***	***8.1***
Total goods & services exports	**2,977**	**3,278**	**4,129**	**4,078**	**3,902**	***-4.3***	***9.5***

Source: Australia's trade by state and territory 2008-09, Australian Department of Foreign Affairs and Trade.
Merchandise figures in reported trade basis, services figures on balance of payment basis.

In Table 3 above, in 2008-09 merchandise exports accounted for 89.2% of the total value of exports while services accounted for 10.8%. Merchandise exports from Tasmania largely consist of primary products and STM[8]. The larger share of merchandise export income was from primary products with 39% of total value, while 31.2% derived from manufactures (26.7% STM and 4.5% ETM[9]) and 19% other exports. Key trends over the past five years include an increase in the value of exports of primary products, with 'other primary products' (including woodchips) exhibiting a five year average trend growth in value of 41.8%, minerals with 27.3%, and unprocessed food with 8.9%. Of note, despite an average 5 year trend growth, exports of 'Other primary products' have been decreasing since 2006-7. Similarly the volume of total manufactures exports has been decreasing from 2006-7, despite an average trend growth of 9.7% over the past 5 years. Services exports primarily consist of travel and transport, which accounted for 9.3% and 0.9% of total export value in 2008-9 respectively, and both had positive growth rates over the period.

Data on state exports is sparse, based predominantly on commodity classifications above, and subject to limitations that make it difficult to accurately estimate export values by destination, in particular for exports to mainland markets in Australia. We can use firm sales data from the Tasmanian Innovation Census as one indicator of the importance of particular export markets by industry in the private sector. Aggregating firm level data from the TIC shows that 19.4% of total sales of goods and services in 2005-2006 were to markets in mainland Australia, 19.2% to overseas markets, and 61.4% to domestic markets. Manufacturing, agriculture, and mining sectors together

[8] Simply Transformed Manufactures.
[9] Elaborately Transformed Manufactures.

accounted for over 90% of total reported sales to overseas markets, and despite showing declining shares of total GVA over time (in Figure 1), TIC data indicates that manufacturing is still a major contributor to exports, accounting for more than three quarters of total sales to overseas markets[10]. Within manufacturing, the most important contributors to overseas sales were primary metal and metal product manufacturing (57.3%), food product manufacturing (14.6%), transport equipment manufacturing (9.9%) and machinery and equipment manufacturing (6.2%).

For total reported sales to mainland markets, agriculture, mining and manufacturing are again among the top contributing industry sectors, indicated by their combined share of 58.5% of total industry sales to mainland markets. Though other sectors with relatively large shares in total industry sales to mainland markets are financial and insurance services (11.3%), transport, postal and warehousing (8.7%) and professional, scientific and technical services (4.3%).

3.3 Employment growth across industry over time

How does employment growth correspond with wider changes in the industrial structure by value added? In Table 4 industries are ranked based on employment growth *within* industry sectors from 1996 to 2006,[11] also showing growth in the number employed, industry contributions to total employment growth, and industry shares in total employment for 2006 (disaggregating broader industry categories in Table 1 to ANZSIC division).

[10] The TIC data includes private sector firms only. Firms were asked to estimate % of total sales by destination to Tasmania, mainland and overseas markets in reference year 2006 and figures are derived from this question. These shares from firms that reported both turnover for 2005- 6 and sales shares by market destination. Firms with missing values are not included in the percentages (though the rate of missing values was low).

[11] (Based on ABS Population Census data)

Table 4. Employment growth by industry

Industry sector	Growth in persons employed by industry 1996-2006 (%)	Growth in persons employed by industry 1996-2006	Industry contribution to total employment growth (1996-2006)	Industry share of total employment 2006
Electricity, gas, water & waste services	158.3%	1,775	8.2%	1.4%
Administrative & support services	50.8%	1,842	8.5%	2.7%
Construction	29.9%	3,146	14.4%	6.7%
Retail trade	27.9%	5,337	24.5%	11.9%
Professional, scientific & technical services	25.6%	1,819	8.4%	4.4%
Accommodation & food services	25.5%	2,884	13.2%	6.9%
Transport, postal & warehousing	24.8%	1,865	8.6%	4.6%
Rental, hiring & real estate services	22.2%	523	2.4%	1.4%
Public administration & safety	19.0%	2,751	12.6%	8.4%
Health care & social assistance	18.2%	3,596	16.5%	11.4%
Education & training	14.6%	2,160	9.9%	8.3%
Financial & insurance services	2.2%	117	0.5%	2.6%
Arts & recreation services	-0.9%	-27	-0.1%	1.4%
Manufacturing	-1.6%	-338	-1.6%	10.3%
Agriculture, forestry & fishing	-5.8%	-699	-3.2%	5.6%
Other services	-6.8%	-513	-2.4%	3.4%
Wholesale trade	-9.0%	-721	-3.3%	3.6%
Mining	-12.8%	-239	-1.1%	0.8%
Information media & telecommunications	-18.6%	-759	-3.5%	1.6%
Inadequately described/Not stated	-34.6%	-2,747	-12.6%	2.5%
Total	**11.9%**	**21,772**	**100.0%**	**100.0%**

Source: ABS cat 2068.0, 1996 census population data purchased from ABS.

Table 4 shows a total increase of 21,772 employed persons from 1996 to 2006 (which averages a 1.2% annual increase of over the period). The main contributors to total employment growth over the period were retail trade, health care and social assistance, construction, accommodation & food services and public administration & safety, together accounting for 81.4% of total growth. Notably, service sectors accounted for all positive growth over the period, while many sector increases correspond with key changes in output:

- Within health care and social assistance, employment increased by 18.2% or 3596 persons, which amounted to the second largest sector contribution to employment growth over the period (16.5%).

- Within *KIBS*, two of three faster growing sectors in value added (by annual growth rates) exhibited higher employment growth, with the number of persons employed in administrative and support services increasing by more than half and by more than a quarter in professional, scientific and technical services; together these sectors accounted for 16.3% of total employment growth in Tasmania over the period. Despite a similarly high annual growth rate in value added for information media & telecommunications, employment decreased by 18.6% suggesting productivity increases. Similarly, although financial and insurance services has shown a growing relative share in total value added in the Tasmanian

economy, employment growth over the past decade within this sector was minimal as was its contribution to state employment growth, implying sectoral productivity gains.

- In transport, postal and warehousing employment increased by around a quarter and accounted for 8.6% of total growth.

- Employment in manufacturing and mining decreased, though importantly manufacturing still accounts for the third largest share of employment of all sectors.

- Despite a higher average annual growth rate in value added (and exports), the number of persons employed in agriculture, forestry and fishing decreased by 5.8% and around 699 employees, suggesting improvements in productivity over the last decade.

3.4 Employment structure in key sectors

We have shown the industry employment shares and contributions to growth at the ANZSIC division level. Here we discuss the distribution of employment by industry subsector for a few sectors, selected based on relative weight in the Tasmanian industry structure, and contribution to changes in output and employment noted above[12]. This allows identification of the main areas of employment within specific industries and where Tasmanian employment distributions significantly differ from Australian distributions; which is useful for considering workforce characteristics unique to the state economy that are relevant to past and future change and industry employment and skills demand.

Within agriculture, forestry and fishing in Tasmania, 67.3% of employment is in agriculture, though this is less than for Australia at 89%. Tasmanian employment is comparatively clustered in forestry and logging (14.5% in Tasmania compared to 2.6% nationally) aquaculture (8.2% compared to 1.2%) and fishing, hunting and trapping (3.9% compared to 1.3% nationally), while agriculture, forestry and fishing support services accounts for 6.1% of industry employment.

Within manufacturing, employment in Tasmania is clustered in food product manufacturing (28.2% compared to 18.8% nationally) and wood product manufacturing (10.9% compared to 5.2%), while sectoral shares of employment in primary metal and metal product manufacturing (11.2%), machinery and equipment manufacturing (7.8%) and transport equipment manufacturing (6.1%) are similar to national shares.

Within professional, scientific and technical services in Tasmania the majority of employment is in legal and accounting services (32.1%) and architectural, engineering and technical services (24.8%). Management and consulting related services accounted for 9% of employment, while the share of employment in scientific

[12] The full table is included in Appendix C.

research services was relatively higher for Tasmania (8.8% compared to 4.3% in the sector nationally).

Within electricity, gas, water and waste services, the majority of employment is in electricity supply (generation, distribution, transmission) which accounts for 74.5% of industry employment compared to 49.1% nationally.

Within transport, postal and warehousing, the majority of employment is in road transport (53.4%), followed by transport support services (13.4%) and postal and courier pick-up and delivery services (13.1%). Water transport accounts for a relatively higher share of employment in this sector in Tasmania (6.3% compared with 1% nationally).

3.5 Productivity by industry

For the longer term, industry productivity levels can provide a key indication of efficiency, competitiveness and growth in economic output. Although data on productivity are not available by industry at the state level, in Table 5 we generate a basic measure using ABS value added and employment data. The links between productivity, employment and skills are complex and not explored here, rather we present the measure as another indicator relevant to industry growth across the Tasmanian economy[13].

[13] The measure in table 4 is derived using chain volume measures for value added (which use a base price year of 2007-8) and number of employees, based on ABS cat 5220.0 and ABS cat 2068.0. Standard labour productivity is calculated using number of hours worked as labour input measure. Using number of employees above does not encapsulate differences in hours and is thus offers a less accurate measure.

Table 5. Productivity change by industry, 1996-2006.

Industry sector	Value added per employee 1996 ($)	Value added per employee 2006 ($)	Labour productivity increase 1996-2006
Information media and telecommunications	56,114	116,496	107.6%
Agriculture, forestry and fishing	52,032	91,419	75.7%
Financial and insurance services	186,541	325,145	74.3%
Professional, scientific and technical services	36,510	56,771	55.5%
Arts and recreation services	33,322	46,328	39.0%
Administrative and support services	36,118	47,175	30.6%
Wholesale trade	79,205	102,263	29.1%
Construction	56,489	72,228	27.9%
Health care and social assistance	56,309	70,199	24.7%
Other services	53,864	65,881	22.3%
Retail trade	36,597	43,418	18.6%
Rental, hiring and real estate services	116,022	134,910	16.3%
Transport, postal and warehousing	122,071	140,237	14.9%
Education and training	70,892	72,656	2.5%
Manufacturing	138,595	133,913	-3.4%
Accommodation and food services	45,992	42,007	-8.7%
Public administration and safety	92,127	82,236	-10.7%
Mining	435,061	310,049	-28.7%
Electricity, gas, water and waste services	677,966	309,392	-54.4%

Source: ABS cat 2068.0, 5220.0, 1996 census population data purchased from ABS.

Table 5 shows productivity increase as the percentage change in industry value added per employee between the last two ABS census periods. Four of six sectors with the highest productivity increases were in knowledge intensive business services, (including information media and telecommunications, financial and insurance services, professional, scientific and technical services, and administrative and support services), and notably agriculture, forestry and fishing exhibited the second highest increase in productivity over the period.

3.6 Occupations in Tasmania

In the previous sections we showed that services make up the largest share of value added in the Tasmanian economy, and that in the last decade employment growth has come entirely from the service sectors. In this section we review structure and change in the distribution of occupation types at the state level and across the Tasmanian industrial structure. We then examine the occupation mix *within* industries, and key industry specific changes over time. The focus in this discussion is on occupations with higher predominant skill levels (1 to 3) according to the standard ANZSCO classification for occupations (shown in Table 6)[14].

[14] Predominant skill levels used in the ANZSCO classification are used as a proxy indicator for skill here, though there are significant limitations with this indicator and caution is urged in their interpretation. The skill level is applicable to the occupation, not the person employed in the occupation,

3.6.1 Changes in the economy-wide occupation mix over time

Table 6 presents two snapshots of the occupation mix across the Tasmanian economy using ABS population census data, adding a third snapshot from the most recent ABS Labour Force Survey as an indication of change since 2006[15]. Changing occupations shares in the workforce between snapshots show increasing levels of higher skilled jobs in the Tasmanian economy:

- The occupation category with the highest predominant skill levels – professionals – contributed the most to total employment growth between 1996 and 2006, and now makes up the largest share of occupations in the Tasmanian workforce. The share of professional occupations has also increased in the 2010 snapshot.
- Community & personal service workers made the second highest contribution to employment growth between census periods (23.4%), followed by sales workers (16.1%) and clerical and administrative workers (14.7%)
- Manager occupations – which have the top two highest predominant skill levels – have more recently increased share of the workforce in 2010.

Table 6. Changing distribution of occupations at the state level, 1996, 2006, 2010.

Occupation	ANZSCO Predominant skill levels	Share of total Occupations 1996	Share of total Occupations 2006	Contribution to total employment growth (1996 to 2006)	Share of total Occupations 2010
Managers	1, 2	13.6%	12.8%	6.2%	13.7%
Professionals	1	16.4%	17.5%	27.3%	18.5%
Technicians & trades workers	2, 3	15.4%	14.6%	8.1%	15.0%
Community & personal service workers	2, 3, 4, 5	8.4%	10.0%	23.4%	9.9%
Clerical & administrative workers	2, 3, 4, 5	13.9%	14.0%	14.7%	14.6%
Sales workers	3, 4, 5	9.2%	9.9%	16.1%	9.9%
Machinery operators & drivers	4	8.5%	7.1%	-4.1%	6.4%
Labourers	4, 5	11.6%	12.5%	20.0%	12.4%

Source: ABS cat 2068.0, 1996 census population data purchased from ABS, ABS Labour Force, Australia, Detailed, Quarterly, cat 6291.0.55.003.

3.6.2 Distribution of occupation types by industry

Table 7 presents a snapshot of the distribution of occupations across different industries (in 2006). Overall the various occupation types are spread fairly widely across industries, though 61.6% of sales workers are in retail trade. There is also some

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and skill sets attached to occupation types can show substantial variation between industries. Difficulties with the conceptualisation, definition and measurement of skill are the subject of a vast literature. For a comprehensive discussion, see Fraser (2010). For further discussion of ANZSCO skill levels see ABS cat 1220.0.

[15] As Labour force data is sourced from a survey, data is subject to relatively high standard errors and is of lower quality than that sourced from the ABS population census.

observable clustering of industries accounting for occupations with higher predominant skill levels (ANZSCO levels 1 to 3)[16]:

- 75.1% of professionals are in four industries: education & training health care & social assistance, public administration & safety, and professional, scientific & technical services.

- 36.6% of managers are in two industries: agriculture, forestry & fishing, and retail trade. 69.5% of managers are in six industries: agriculture, forestry & fishing, retail trade, accommodation & food services, manufacturing, construction, public administration & safety .

- 66.8% of technicians and trade workers are in three industries: construction, manufacturing, and other services.

[16] Industries with relatively higher shares of particular occupations are shaded in Table 7.

Table 7. Distribution of occupations across industry, 2006.

Industry	Managers	Professionals	Technicians & trades workers	Community & personal service workers	Clerical & administrative workers	Sales workers	Machinery operators & drivers	Labourers	Inadequately described/Not stated	Total
Agriculture, forestry & fishing	**20.3%**	1.3%	2.0%	0.2%	2.0%	0.2%	5.6%	**13.3%**	3.5%	5.6%
Mining	0.5%	0.5%	1.3%	0.0%	0.3%	0.0%	5.2%	0.3%	0.4%	0.8%
Manufacturing	**8.5%**	3.4%	**20.0%**	1.1%	5.5%	5.2%	**24.2%**	**20.0%**	8.9%	10.3%
Electricity, gas, water & waste services	1.5%	1.8%	2.6%	0.0%	1.9%	0.2%	1.8%	0.7%	1.0%	1.4%
Construction	**7.9%**	0.6%	**23.2%**	0.1%	4.1%	0.5%	**8.7%**	6.9%	3.5%	6.7%
Wholesale trade	4.2%	1.2%	2.7%	0.1%	3.8%	7.5%	**8.2%**	4.3%	2.0%	3.6%
Retail trade	**16.3%**	1.9%	5.8%	1.2%	6.1%	**61.6%**	5.6%	8.9%	3.7%	11.9%
Accommodation & food services	**9.6%**	0.4%	5.9%	**18.9%**	2.3%	7.8%	1.2%	**13.3%**	3.5%	6.9%
Transport, postal & warehousing	3.0%	1.1%	1.5%	1.7%	6.3%	3.1%	**29.0%**	2.5%	2.5%	4.6%
Information media & telecommunications	1.1%	2.7%	2.6%	0.0%	2.7%	1.6%	0.3%	0.3%	1.2%	1.6%
Financial & insurance services	2.5%	3.1%	0.2%	0.1%	**11.1%**	1.0%	0.0%	0.1%	2.3%	2.6%
Rental, hiring & real estate services	1.2%	0.5%	0.4%	0.2%	2.2%	6.4%	0.6%	0.7%	1.3%	1.4%
Professional, scientific & technical services	2.7%	**11.8%**	3.8%	0.4%	8.1%	0.6%	0.4%	0.8%	1.8%	4.4%
Administrative & support services	1.5%	1.9%	2.5%	2.2%	3.7%	0.6%	1.2%	7.1%	1.4%	2.7%
Public administration & safety	**6.9%**	**12.8%**	3.8%	**14.8%**	**17.8%**	0.4%	3.1%	3.2%	6.7%	8.4%
Education & training	4.1%	**28.5%**	2.7%	**11.1%**	5.4%	0.2%	0.3%	3.3%	1.2%	8.3%
Health care & social assistance	3.3%	**22.0%**	3.0%	**40.2%**	**11.1%**	0.5%	1.1%	7.2%	4.4%	11.4%
Arts & recreation services	1.5%	1.5%	1.2%	3.7%	1.4%	0.6%	0.2%	1.1%	1.1%	1.4%
Other services	1.8%	1.7%	**11.9%**	2.7%	2.7%	0.8%	0.9%	2.7%	1.4%	3.4%
Inadequately described/Not stated	1.5%	1.1%	2.9%	1.1%	1.6%	1.2%	2.3%	3.1%	48.3%	2.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Distribution of occupations-Tasmania	**12.8%**	**17.5%**	**14.6%**	**10.0%**	**14.0%**	**9.9%**	**7.1%**	**12.5%**	**1.5%**	100.0%

Source: ABS cat 2068.0, 1996 census population data purchased from ABS

3.6.3 Industry contributions to economy-wide growth in high skill occupations

Disaggregating data further can reveal specific industry contributions to the positive growth in higher skill occupations between 1996 and 2006[17]. As could be expected, most growth is driven by industries with clustering of occupation types identified from Table 7 above:

For professionals:

- Public administration and safety was the largest contributor to positive employment growth in professional occupations over the period, (accounting for approximately 24.1% of growth), followed by education and training (23.4%), professional, scientific and technical services (18.3%), and health care and social assistance (12.3%)
- These were followed by electricity, gas, water and waste services (9.5%), Financial and insurance services (7.5%), administrative and support services (6.7%), retail trade (2.1%) and agriculture, forestry and fishing (1.2%)

For Managers:

- The construction sector was the largest contributor to positive employment growth in manager occupations (accounting for approximately 45.3%), followed by retail trade (33%), public administration and safety (24.4%), electricity, gas, water and waste services (23.9%), and manufacturing (approximately 16.8%).

For Technicians & trades workers:

- The construction sector accounted for 84.9% of total growth in technician & trade worker occupations, followed by electricity, gas, water and waste services, (24.8%), accommodation and food services (23.2%), administrative and support services (17.9%) and professional, scientific and technical services (10.5%).

3.6.4 Distribution of occupation types within industry

What is the relative importance of skilled occupations *within* particular industries? We have observed the industry spread of broad occupation types across the economy and industry contributions to growth in occupation types, though not the relative distribution of occupation types *within* industries. This can provide further indication of specific industry demand for particular types of occupation and correspondent skills. In Table 8, a few points stand out in respect to the share of higher skilled occupations (ANZSCO predominant skill levels 1 to 3) *within* industry:

- In education and training, 60.5% of the workforce are professionals

- Within knowledge intensive business services:
    - In professional, scientific and technical services 47.6% of the workforce are professionals,
    - In health care and social assistance and information, media and communications around a third of the workforce are professionals

[17] As growth is both positive and negative depending on industry sector, totals don't sum to 100%. The full table is included in Appendix D.

- In agriculture, forestry and fishing, 46.8% of persons employed are classified as managers.
- Within construction, 50.9% of the workforce are technicians and trade workers,
- In other services, 50.5% of the workforce are technicians and trade workers

Table 8. Distribution of occupations within industry sectors, 2006.

Industry	Managers	Professionals	Technicians & trades workers	Community & personal service workers	Clerical & administrative workers	Sales workers	Machinery operators & drivers	Labourers	Inadequately described/Not stated	Total
Agriculture, forestry & fishing	**46.8%**	4.2%	5.2%	0.4%	5.0%	0.4%	7.2%	**29.9%**	0.9%	100.0%
Mining	7.5%	10.4%	**23.3%**	0.6%	5.3%	0.2%	**46.7%**	5.3%	0.7%	100.0%
Manufacturing	10.5%	5.7%	**28.3%**	1.0%	7.4%	5.0%	**16.6%**	**24.1%**	1.3%	100.0%
Electricity, gas, water & waste services	**13.9%**	**22.0%**	**26.8%**	0.3%	**18.6%**	1.5%	**9.2%**	6.5%	1.1%	100.0%
Construction	**15.1%**	1.6%	**50.9%**	0.1%	8.6%	0.7%	**9.3%**	12.8%	0.8%	100.0%
Wholesale trade	**15.2%**	5.9%	11.2%	0.4%	14.8%	**20.6%**	**16.3%**	**14.9%**	0.8%	100.0%
Retail trade	**17.6%**	2.8%	7.1%	1.0%	7.2%	**51.2%**	3.3%	9.3%	0.5%	100.0%
Accommodation & food services	**17.8%**	1.0%	12.4%	**27.2%**	4.7%	**11.1%**	1.2%	**23.9%**	0.8%	100.0%
Transport, postal & warehousing	8.4%	4.4%	4.7%	3.8%	**19.3%**	6.7%	**45.1%**	6.8%	0.8%	100.0%
Information media & telecommunications	8.7%	**29.6%**	**23.8%**	0.3%	**22.9%**	9.6%	1.4%	2.7%	1.1%	100.0%
Financial & insurance services	12.3%	**21.0%**	0.9%	0.5%	**59.5%**	3.7%	0.1%	0.7%	1.3%	100.0%
Rental, hiring & real estate services	11.3%	6.3%	4.3%	1.2%	**21.7%**	**45.0%**	3.0%	5.8%	1.4%	100.0%
Professional, scientific & technical services	7.9%	**47.6%**	12.8%	0.8%	**26.0%**	1.3%	0.6%	2.3%	0.6%	100.0%
Administrative & support services	7.1%	12.3%	13.6%	8.3%	**19.4%**	2.2%	3.1%	**33.2%**	0.8%	100.0%
Public administration & safety	10.5%	**26.6%**	6.6%	**17.6%**	**29.7%**	0.5%	2.7%	4.7%	1.2%	100.0%
Education & training	6.4%	**60.5%**	4.7%	**13.4%**	9.2%	0.2%	0.3%	5.0%	0.2%	100.0%
Health care & social assistance	3.8%	**33.8%**	3.9%	**35.2%**	13.6%	0.5%	0.7%	7.9%	0.6%	100.0%
Arts & recreation services	**13.8%**	18.3%	12.2%	**25.7%**	13.8%	4.5%	0.9%	9.8%	1.1%	100.0%
Other services	6.9%	8.9%	**50.5%**	7.9%	11.2%	2.3%	1.8%	9.8%	0.6%	100.0%
Inadequately described/Not stated	7.5%	7.9%	16.9%	4.5%	8.6%	4.6%	6.5%	15.3%	28.2%	100.0%
Total	**12.8%**	**17.5%**	**14.6%**	**10.0%**	**14.0%**	**9.9%**	**7.1%**	**12.5%**	**1.5%**	**100.0%**

Source: ABS cat 2068.0, 1996 census population data purchased from ABS.

3.6.5 Changes in the distribution of occupation types within industry over time

We have shown that at the economy-wide level, the number and relative share of persons in higher skill occupations in Tasmania has been increasing over time. A snapshot of the occupational distribution across the economy showed some industry clusters of higher skill occupations, which are also the drivers of the majority of growth in higher skill occupations in the last decade. Table 8 indicated relative importance for higher skill occupation types and skills *within* specific industries, though provided no indication of the pace of change in industry requirements over time. In which industries are higher skill occupations increasing at faster rates? Table 9 shows the percentage growth in occupation types *within* industries between the two ABS Census periods, as well as the corresponding growth in numbers. The rationale for this table is to identify growth rates in higher skill occupation types both from the industry perspective (percentage change) and in terms of absolute growth in numbers employed, and to enable identification of the shifting occupation mix for sectors of interest, such as those that in terms of output measures are larger or faster growing.

Compared to other sectors, the very high growth rates across occupations in electricity, gas, water and waste services are due to growth off a very small base number of employees in 1996, and the employment resulting from state infrastructure projects undertaken over the past decade (such as basslink, natural gas, and wind farms). Nevertheless, higher skilled professional and manager occupations exhibited the most growth in this sector.

Focusing on sectors with higher than average growth rates in high skill occupations (ANZSCO predominant skill levels 1 to 2), a few points stand out[18].
Sectors with the largest increases in professional occupations include[19]:

- KIBS:
    - Professional occupations increased by 143.3% in administrative and support services, 66.3% in financial and insurance services, and 34.6% in professional, scientific and technical services
- In public administration and safety, professionals increased by 45.5%

Sectors with the highest growth rates in manager occupations include:[20]

- Construction, manager occupations increased by 41.8%,
- *KIBS*:
    - In administrative and support services the number employed in manager occupations increased by 40.2%,
    - In professional, scientific and technical services the number employed in manager occupations increased by 23%
- In public administration and safety manager occupations increased by 22.3%

[18] In some occupation types with large percentage changes, the corresponding change in actual number of employed persons is low, because the share of employment in that occupation type is a small for that industry, the number is a better indicator in this case.
[19] Approximately double the average increase in professional occupations at the state level.
[20] Greater than four times the average increase in manager occupations at the state level.

Table 9. Industry growth in persons employed by occupation, 1996-2006.

Industry	Managers		Professionals		Technicians & trades workers		Community & personal service workers		Clerical & administrative workers		Sales workers		Machinery operators & drivers		Labourers	
Agriculture, Foresty and Fishing	-6.8%	-387	17.2%	70	-13.8%	-95	-37.5%	-30	18.9%	-30	-42.5%	-37	-26.2%	-290	1.4%	48
Mining	-9.0%	-12	-16.3%	-33	-11.2%	-48	42.9%	3	-32.0%	3	0.0%	0	-5.4%	-43	-25.9%	-30
Manufacturing	11.4%	227	-3.8%	-48	-1.3%	-82	26.9%	46	-6.7%	46	4.1%	42	-17.5%	-746	10.6%	492
Electricity, Gas, Water and Waste Services	397.5%	322	752.0%	564	128.2%	436	-10.0%	-1	209.8%	-1	25.7%	9	-0.7%	-2	71.8%	79
Construction	41.8%	611	-0.4%	-1	27.4%	1495	-45.9%	-17	20.9%	-17	11.6%	10	29.7%	292	52.3%	603
Wholesale Trade	-12.3%	-156	-8.3%	-39	-24.6%	-269	64.7%	11	-26.4%	11	-12.8%	-223	-0.7%	-9	53.4%	380
Retail Trade	11.6%	446	22.4%	126	-4.9%	-90	40.3%	71	43.6%	71	38.6%	3481	-36.2%	-463	136.6%	1317
Accommodation and Food Services	2.9%	70	-36.4%	-83	30.1%	409	42.2%	1146	25.3%	1146	9.7%	140	-19.0%	-40	47.6%	1094
Transport Postal and Warehousing	4.9%	37	10.5%	39	-11.3%	-56	68.4%	143	31.1%	143	86.1%	292	24.2%	824	39.0%	180
Information Media and Telecommunications	-6.2%	-19	-15.1%	-175	-34.0%	-408	-69.0%	-20	-15.0%	-20	24.6%	63	-16.4%	-9	-31.0%	-40
Financial and Insurance Services	-13.1%	-99	66.3%	447	-4.1%	-2	-39.0%	-16	-2.8%	-16	-37.5%	-119	-72.2%	-13	-27.1%	-13
Rental, Hiring and Real Estate Services	12.8%	37	30.9%	43	-34.9%	-67	-40.4%	-23	38.1%	-23	48.1%	420	-38.3%	-54	-3.5%	-6
Professional, Scientific and Technical Services	23.0%	132	34.6%	1090	19.3%	185	-9.9%	-8	26.0%	-8	-36.2%	-64	-33.7%	-28	17.8%	31
Administrative and Support Services	40.2%	111	143.3%	397	73.5%	316	23.1%	85	100.2%	85	-30.9%	-54	47.8%	55	29.8%	417
Public Administration and Safety	22.3%	330	45.5%	1431	-2.7%	-32	44.4%	932	12.7%	932	-29.1%	-37	-18.8%	-106	-6.7%	-59
Education and Training	16.9%	156	15.7%	1390	-9.6%	-85	45.9%	715	15.6%	715	-56.7%	-55	-40.0%	-30	-9.2%	-87
Health Care and Social Assistance	-0.2%	-2	10.2%	732	8.0%	67	36.6%	2206	19.8%	2206	-2.6%	-3	-11.6%	-22	4.3%	77
Arts and Recreation Services	14.2%	50	9.5%	46	3.2%	11	-2.3%	-18	-9.7%	-18	-15.5%	-24	-40.0%	-18	-8.3%	-26
Other Services	-26.8%	-178	-8.5%	-58	4.8%	164	-2.1%	-12	-14.8%	-12	-45.6%	-136	-42.5%	-96	-5.2%	-38
Total Occupation	5.4%	1,350	19.8%	5,943	6.2%	1,761	33.1%	5,086	12.5%	3,192	20.9%	3,510	-5.8%	-901	20.5%	4,358

Source: ABS cat 2068.0, 1996 census population data purchased from ABS.

3.7 Distribution of employment by age across industry

The age profile of the workforce is an important factor to consider in terms of industry composition, skills requirements and growth potential, and Tasmania has a significantly faster ageing population than the rest of Australia (DCAC, 2008). The age profile of the Tasmanian population and workforce has potential to exacerbate skills shortages, as retirements in an ageing workforce create replacement demand.

Table 10. Change in workforce age by industry – 1996-2006.

Industry	15-19 years	20-34 years	35-44 years	45-54 years	55+	Total
Agriculture, Forestry and Fishing	3.8%	23.8%	22.7%	23.3%	26.4%	100.0%
Rental, Hiring and Real Estate Services	5.4%	28.1%	21.2%	23.2%	22.2%	100.0%
Transport Postal and Warehousing	1.9%	22.4%	26.5%	28.0%	21.2%	100.0%
Education and Training	1.1%	20.5%	24.8%	34.6%	19.0%	100.0%
Professional, Scientific and Technical Services	3.0%	31.3%	23.9%	23.2%	18.6%	100.0%
Health Care and Social Assistance	1.5%	20.9%	26.2%	33.5%	18.0%	100.0%
Wholesale Trade	4.4%	30.0%	26.8%	23.3%	15.5%	100.0%
Other Services	7.6%	31.1%	23.0%	22.8%	15.4%	100.0%
Arts and Recreation Services	8.1%	30.8%	21.7%	24.2%	15.2%	100.0%
Information Media and Telecommunications	3.7%	29.5%	24.7%	26.9%	15.2%	100.0%
Administrative and Support Services	5.1%	29.8%	25.2%	24.8%	15.1%	100.0%
Public Administration and Safety	1.2%	25.5%	28.4%	30.0%	14.9%	100.0%
Mining	1.3%	25.3%	31.6%	28.4%	13.4%	100.0%
Construction	7.1%	29.9%	24.9%	24.8%	13.3%	100.0%
Manufacturing	6.1%	29.5%	27.4%	23.9%	13.2%	100.0%
Electricity, Gas, Water and Waste Services	1.1%	28.3%	29.9%	28.0%	12.7%	100.0%
Retail Trade	17.9%	33.4%	19.6%	17.6%	11.6%	100.0%
Accommodation and Food Services	22.4%	33.4%	16.5%	16.5%	11.1%	100.0%
Financial and Insurance Services	3.3%	38.3%	25.6%	22.2%	10.6%	100.0%
Inadequately described/Not stated	8.8%	25.7%	20.9%	21.0%	23.6%	100.0%
Total Tasmania	**6.7%**	**27.8%**	**24.2%**	**25.3%**	**15.9%**	**100.0%**
Total Australia	**6.5%**	**31.6%**	**24.0%**	**22.8%**	**15.1%**	**100.0%**

Source: ABS cat 2068.0, 1996 census population data purchased from ABS.

Table 10 shows the percentage distribution in persons employed by age category for each industry sector, illustrating the relative severity of the ageing population structure of the Tasmanian workforce relative to Australia. The share of persons employed in the 45-54 year age group is 25.3% compared to 22.8% for Australia, and 15.9% in the 55+ age group compared with 15.1% nationally.

Replacement demand is more likely to pose an issue for sectors with higher shares of employees in older age brackets and lower shares in younger age brackets. In this respect a few sectors stand out in table 10.

Agriculture, forestry and fishing has the highest share of employees in the 55+ age category, as well as lower than average shares of employees in both the 20-34 year and 35-44 year age groups. Transport, postal and warehousing, education and training, and health care and social assistance all have higher than average shares of employees in both the 45-54 year and 55+ age groups, and a lower than average shares of employees in the 20-34 year age group.

Previous research has identified these sectors in terms of their more vulnerable workforce age profile (Skills Tasmania, 2009), and they should be of greater policy interest considering their importance in terms of output, employment and growth in the Tasmanian economy.

3.8 Qualifications levels in Tasmanian industry

Traditionally, Tasmania has had lower workforce participation rates, higher unemployment rates and lower levels of post school qualifications compared with the rest of Australia; consistently ranking lowest of all states based on the qualification index in the state Treasury department's annual competition index, though this is partly due to the industrial structure (DOTAF, 2008).

Skill shortages can be more pronounced for sectors with large shares of occupations requiring higher level qualifications as they take a longer time to acquire, and qualification levels provide one key indicator of skill in the workforce[21]. Changes in the mix of qualifications over time by occupation and industry can indicate shifts in demand for certain qualification levels across the economy, and assist in identifying areas where a lack of suitably qualified employees may present a more severe constraint to growth. Qualification levels are also of relevance for the knowledge economy, providing a representation of the stock of knowledge or human capital that can impact on productivity, innovation and growth.

Overall, 17.2% of the Tasmanian workforce was qualified to degree level or above in 2006 compared with 29.7% nationally[22], with the highest concentration in professional occupations (68% of professionals in Tasmania were qualified to this level). Evidently sectors which have higher numbers of professionals also have the highest shares of persons qualified to degree level or above, with 50 per cent or more of the industry workforce qualified to this level in education and training, professional scientific and technical services, and public administration and safety (Skills Tasmania, 2009). A breakdown in qualifications by occupation type is included in appendix E.

What is not obvious from previous studies is how the qualification mix within industry has changed over time, which can assist in locating changing industry demand for certain skill levels. Table 11 shows the share of employees with particular qualification types in each industry in 1996 and then 2006, indicating the changing skill level in industry in over this period[23].

[21] There are many limitations with qualification level as an indicator of skill. For example data refers to the highest level of qualification so multiple qualifications are not reflected, and qualification is not indicative of experience. Qualification level is a proxy for skill and caution needs to be exercised in interpretation.

[22] Based on ABS population Census data, Cat. 2608.0, level of educational attainment by industry

[23] Horizontal totals don't add to 100% as the 'inadequately described' category for qualification is not included.

3.8.1 Changes in the qualifications mix over time

Table 11 shows a decrease in the share of the workforce with no post school qualification over the past decade. Over the same period, the share of the workforce with certificate level qualifications increased the most (by 6.2 percentage points) followed by bachelor degree level qualifications (by 4 percentage points).

Industries with the greatest increases in the share of employees qualified to bachelor degree or higher include electricity, gas, water and waste services, professional, scientific and technical services, education and training , public administration and safety, health care and social assistance, arts and recreation services, and finance and insurance services; all of which are service sectors.

Industries with the greatest increases in the share of employees qualified to postgraduate degree level include electricity, gas, water and waste services, education and training, professional, scientific and technical services, and public administration and safety, arts and recreation services, mining, and financial and insurance services[24].

[24] Includes industries with a percentage point increase between periods greater than the average across all industries. 'Bachelor degree or higher' category aggregates postgraduate degree, graduate degree and graduate certificate, bachelor degree.

Table 11. Change in relative shares of qualifications by industry 1996-2006.

Industry	Postgraduate degree level qualification		Graduate Diploma and Graduate Certificate level qualification		Bachelor Degree level qualification		Advanced Diploma and Diploma level qualification		Certificate Level qualification		No Post School Qualification	
	1996	2006	1996	2006	1996	2006	1996	2006	1996	2006	1996	2006
Agriculture, Foresty and Fishing	0.5%	1.0%	0.3%	0.6%	3.5%	5.9%	5.3%	6.5%	13.6%	18.7%	70.1%	61.2%
Mining	0.9%	2.0%	0.6%	0.6%	7.4%	8.1%	3.8%	4.1%	29.5%	33.5%	51.9%	47.5%
Manufacturing	0.5%	0.7%	0.3%	0.4%	3.5%	4.5%	3.6%	4.6%	26.3%	33.4%	59.2%	51.4%
Electricity, Gas, Water and Waste Services	0.4%	4.6%	0.4%	1.7%	4.2%	18.4%	7.8%	11.7%	30.9%	32.6%	49.2%	28.0%
Construction	0.1%	0.2%	0.2%	0.2%	1.5%	2.2%	2.8%	3.2%	46.7%	51.1%	41.1%	39.3%
Wholesale Trade	0.2%	0.3%	0.2%	0.4%	2.8%	4.3%	3.6%	5.0%	20.8%	25.6%	65.9%	59.5%
Retail Trade	0.1%	0.3%	0.6%	0.5%	3.0%	4.9%	2.6%	3.5%	13.0%	18.6%	74.0%	67.2%
Accommodation and Food Services	0.2%	0.4%	0.5%	0.3%	3.2%	5.1%	3.7%	4.2%	12.5%	19.2%	73.1%	65.4%
Transport Postal and Warehousing	0.2%	0.4%	0.2%	0.3%	1.7%	3.1%	4.1%	5.2%	18.3%	23.6%	68.8%	61.2%
Information Media and Telecommunications	4.1%	1.6%	2.3%	2.7%	9.8%	13.1%	7.7%	11.8%	19.8%	21.7%	48.9%	44.1%
Financial and Insurance Services	0.4%	1.4%	0.7%	1.5%	7.0%	12.1%	6.9%	14.0%	8.2%	18.0%	70.6%	49.0%
Rental, Hiring and Real Estate Services	0.3%	0.9%	0.6%	1.4%	5.5%	7.5%	10.2%	12.2%	20.7%	23.2%	55.3%	49.2%
Professional, Scientific and Technical Services	4.6%	6.7%	2.2%	3.0%	26.7%	33.9%	10.4%	10.6%	12.1%	14.5%	38.2%	27.9%
Administrative and Support Services	0.5%	1.0%	0.9%	1.0%	4.1%	6.7%	5.3%	7.0%	14.3%	24.7%	68.5%	54.5%
Public Administration and Safety	2.7%	4.5%	2.9%	4.3%	15.4%	21.5%	9.9%	10.6%	12.8%	19.4%	50.4%	35.1%
Education and Training	6.9%	9.8%	9.3%	5.5%	30.3%	40.7%	14.7%	10.5%	6.6%	11.6%	27.7%	18.6%
Health Care and Social Assistance	2.6%	3.3%	1.5%	2.5%	17.0%	23.1%	18.1%	12.5%	10.6%	20.3%	41.6%	30.8%
Arts and Recreation Services	1.4%	2.7%	1.5%	1.6%	7.7%	13.8%	5.7%	8.8%	13.0%	19.5%	63.5%	48.6%
Other Services	0.7%	1.5%	0.9%	0.9%	5.1%	5.8%	4.8%	6.5%	38.0%	47.0%	42.0%	34.0%
Inadequately described/Not stated	0.7%	1.2%	0.5%	0.6%	2.9%	5.4%	3.4%	4.9%	14.9%	21.2%	62.5%	52.5%
Total	**1.6%**	**2.4%**	**1.6%**	**1.6%**	**9.1%**	**13.1%**	**7.2%**	**7.4%**	**17.8%**	**24.0%**	**55.6%**	**46.2%**

Source: ABS cat 2068.0, 1996 census population data purchased from ABS.

3.8.2 Tertiary qualifications in the private sector

In the Tasmanian Innovation Census firms were asked to report the number of tertiary qualified employees in 'science and engineering' and 'other' disciplines, and resultant data can provide further indication of skills clustering across the private sector economy in these categories. Table 12 below shows the reported number of tertiary qualified employees in the two categories as a share of total reported employees for each industry division.

Table 12.Share of tertiary qualified employees by industry.

ANZSIC 2006 Division	Share of total employees with science or engineering qualifications	Share of 'other' qualified
M. Professional, Scientific and Technical Services	27.8%	23.7%
Q. Health Care and Social Assistance	15.8%	6.6%
A. Agriculture, Forestry and Fishing	6.7%	3.8%
D. Electricity, Gas, Water and Waste Services	6.1%	4.2%
B. Mining	5.8%	2.4%
R. Arts and Recreation Services	5.3%	9.3%
C. Manufacturing	4.7%	2.8%
L. Rental, Hiring and Real Estate Services	4.0%	9.5%
S. Other Services	3.7%	1.7%
J. Information Media and Telecommunications	3.1%	11.0%
E. Construction	2.6%	1.6%
G. Retail Trade	2.2%	3.8%
N. Administrative and Support Services	2.2%	6.5%
H. Accommodation and Food Services	1.6%	5.5%
F. Wholesale Trade	1.6%	2.2%
P. Education and Training	1.5%	25.8%
K. Financial and Insurance Services	1.2%	20.1%
I. Transport, Postal and Warehousing	0.9%	3.6%
O. Public Administration and Safety	0.8%	1.9%
Total	**5.9%**	**5.8%**

Source: Tasmanian Innovation Census data.

Of industries with above average shares of employees with science and engineering qualifications, professional, scientific and technical services has the highest share followed by health care and social assistance, agriculture, forestry and fishing and electricity, gas, water and waste services. For employees with 'other' tertiary qualifications, education and training, professional, scientific and technical services, financial and insurance services, and information media and telecommunications had relatively higher shares (approximately double the average or more). This indicates the importance of human capital based knowledge inputs to what have been traditionally considered as low-technology industries such as agriculture, forestry and fishing and utilities, though also the services sectors such as financial services.

4 Industries with potential – deeper capability and Innovation

The previous sections of this paper provided a descriptive overview of the structure of the Tasmanian economy and major changes occurring in the composition of value-added, employment, occupation and qualifications, noting larger and higher growth sectors, the sectoral distribution of basic workforce characteristics, and trends that may be indicative of continued sources of growth and business demand for skills. A key objective of this paper is to set a platform to guide further study of the Tasmanian industrial structure, and the role of innovation in growth. In addition to presenting a data driven, descriptive picture of historic structural change we seek to identify sectors exhibiting potential for future output and employment growth, and to inform efforts to understand employment and skills requirements associated with innovation and future growth.

4.1 Uncertainty, future conditions and predictions

Attempting to predict future employment and skill requirements in a dynamically changing economy presents a perennial issue for researchers and policy makers, largely due to the inherent uncertainty around future local, national and global economic conditions. Attempting to make detailed predictions about the future with any accuracy can be a difficult if not impossible task. Previous research suggests that even the best methods to predict future skills requirements in Australia have resulted in figures that dissipate substantially in accuracy after a few years and much more significantly after nine years (Richardson & Tan, 2007). Problems with accuracy of prediction are only exacerbated by disaggregation to more detailed levels by industry, occupation and region (Richardson & Teese, 2008). Nonetheless, policy makers must address skill shortages and plan for skills based on some informed estimation or picture of the future economic landscape and demand for skills. Richardson & Tan (2007) suggest a best approach focuses on identifying skills in growing and declining demand, locating urgencies in replacement demand, and targeting skills that take a long time to acquire, while current economic modelling by Skills Australia draws on changes in the Australian economy over the past 30 years to provide forecasts under three global economic scenarios (Access Economics, 2009)[25]. Other discussions on skills for the future for Tasmania and Australia revolve around identifying priority sectors, those with the most potential for future growth, and new and emerging or more innovative industries (see for example the Tasmanian Skills Strategy 2008-2015; Richardson and Teese, 2007; Misko and Saunders, 2004).

Describing the Tasmanian industrial structure and major changes occurring is an important step in identifying characteristics that shape the Tasmanian economy and may influence its future structure; though the overview has been intentionally broad so far. Thinking about industries with future potential and implications for skills and employment profiles requires deeper exploration, both in terms of unpacking further

[25] Under two scenarios for Australia, professional, scientific and technical services, transport, postal and warehousing, and health care and social assistance have the top three highest predicted annual average employment growth rates over the next 15 yrs, while in the third scenario the top three industries include electricity, gas, water and waste services, professional, scientific and technical services and health care and social assistance.

detail in the data presented so far and from expanding the perspective to consider the central role of innovation and productivity in longer term economic growth.

The aim of this section is not to attempt to model for or predict the future, but to identify those industries that exhibit revealed deep capability and higher levels of innovation, where these characteristics provide one indication of potential future growth and significance for employment and skills. The discussion draws on the analytical approach of the 2009 Tasmanian Innovation Strategy, further exploring some dimensions in the economy discussed hitherto and reviewing innovation across the Tasmanian industrial structure.

4.2 Productivity and innovation and revealed deep capability in sector output and employment

In the longer term, governments, scholars and policymakers across the globe recognise that increases in productivity are the key to sustained economic growth and improved standards of living. Increases in the amount of economic output produced per unit of input derive from increasing the quality of both labour and capital inputs, through improvements in learning, knowledge, skill, technology and innovation. A wide body of empirical research shows that such qualitative improvement, often referred to as technical change in the literature, has been a major source of historically documented economic growth (Verspagen, 2005; Toner & Marceau et al, 2004). As a major component of technical change, innovation is a key driver of productivity, competitiveness and growth. Any consideration of what industries might be important in the future needs to take into account both the existing size of industry contributions to value added and output, and industry capacity to support ongoing innovation and productivity advance (West, 2009).

Identifying *revealed deep capability* in the economy is one way of thinking about industry potential to contribute to future productivity driven growth. Deep capabilities are those aspects of an economy or industry that 'are difficult for others to emulate and support ongoing gains in competitiveness', and are indicated by characteristics of economic specialisation, geographical concentration and sectoral specificity (West, 2009). One method of recognising such characteristics is by identifying industry sectors in which Tasmania's share of national industry activity is greater than its share of the Australian economy and population (currently 1.8% and 2.3% respectively)[26]. West (2009) argues that such disproportionate sectoral shares in national activity provide an indication of existing deeper capability, advantage, potential for productivity increase and growth - assuming this logic they might also have relevance to future employment and skills demand.

Based on this approach, Table 13 shows Tasmanian industry gross value added as a share of Australian industry GVA, as well as industry shares in total value added in Tasmania and nationally.

[26] ABS cat 5220.0, 3101.0.

Table 13. Tasmanian industry GVA share in Australian industry GVA, 2009

Industry	Tasmanian industry - GVA shares in Australian GVA (%)	Tas industry % of total Tas GVA	Aus industry % of total Aus GVA
Agriculture, forestry and fishing	3.9	5.7	2.4
Electricity, gas, water and waste services	3.1	4.5	1.6
Health care and social assistance	2.8	9.0	6.1
Public administration and safety	2.5	7.2	5.5
Education and training	2.5	6.1	4.4
Manufacturing	2.4	12.7	9.4
Accommodation and food services	2.3	3.3	2.4
Transport, postal and warehousing	2.2	6.7	5.4
Retail trade	2.1	5.7	4.9
Total - all industries GVA	**1.8**	**61.0**	**42.1**

Source: ABS Cat 5220.0. Based on chain volume measures.

Agriculture, forestry and fishing has the largest share in national industry gross value added with 3.9%, followed by electricity, gas, water and waste services with 3.1%.

The largely public sectors of health, public administration and safety and education all have greater shares, while manufacturing, accommodation and food services, transport, postal and warehousing and retail trade also exhibit higher shares in national industry value-added than the average for all industries. The relative importance of these sectors in Tasmania is also reflected in their higher shares in total value added compared to national shares.

These figures correspond with the picture presented in earlier sections at the broad ANZSIC division level: in the private sector economy agriculture, forestry and fishing, electricity, gas and water and manufacturing are all important sectors for output and employment in Tasmania, and deeper capability is indicated by disproportionate shares in national value added. However, more specifically locating deeper capabilities requires disaggregating data to a finer level of detail than ANZSIC industry division. GVA data is not available in more detail, and in the Tasmanian Innovation Strategy paper industry employment share is used to indicate sectoral advantage and capability, showing that the specific areas in which Tasmania exhibits notable specialisation are in food production, agriculture, forestry and associated activities, and electricity and mineral processing derived from electricity generation (West, 2009).

We can apply the same analytical approach to occupation employment share, identifying specific occupation types in which Tasmanian accounts for a disproportionately large share of national employment. Using the most recent ANZSCO classification at the finest level of detail, Table 14 shows occupations with shares in national employment greater than approximately double the population share.

The figures appear to reiterate the areas of advantage identified in the Tasmanian Innovation Strategy, though go further in adding some notion of skill to identified areas of deep capability and advantage (based on the indicative skill levels attached to particular occupation types). In aquaculture, Tasmania accounts for 16% of

aquaculture farmers (managers) 34.8% of aquaculture workers and 8.5% of deck and fishing hands (labourers). In Forestry, Tasmania accounts for 19.7% of forestry and logging workers, 7.8% of timber and wood process workers, and 6.9% of paper and wood processing machine operators (Labourers). In food production Tasmania has high shares of food and drink factory workers (5.3%), meat, poultry, and seafood process workers (5.1%), and food trades assistants (4.4%), which are all labourer positions. In Agriculture, Tasmania accounts for 7.6% of Australia's Agricultural and Forestry scientists (professionals), 5.1% of agricultural technicians (technicians and trade workers), and 6.1% of Australia's agricultural, forestry and horticultural plant operators (Machinery operators and drivers).

Tasmania has larger shares of higher skill professionals with 5% of Australian marine transport officials and 5% of life scientists. Tasmania also has 6.4% of Australia's gallery, library, and museum technicians, and 4.2% of gallery, museum and tour guides.

It is important to note that the data here is from 2006, and so doesn't reflect recent developments with a negative impact on employment such as firm closures in forestry and manufacturing sectors.

Table 14. Tasmanian employment share by occupation, 2006.

ANZSCO Level Major -level	Minor group name	Unit group name	Tasmanian share of Australian employment by occupation	Persons employed Tasmania	Persons employed Australia
Labourers	Farm, Forestry and Garden Workers	Aquaculture Workers	34.8%	204	587
Labourers	Farm, Forestry and Garden Workers	Forestry and Logging Workers	19.7%	667	3379
Managers	Farmers and Farm Managers	Aquaculture Farmers	16.0%	303	1898
Labourers	Miscellaneous Labourers	Deck and Fishing Hands	8.5%	588	6933
Labourers	Miscellaneous Factory Process Workers	Timber and Wood Process Workers	7.8%	638	8166
Professionals	Natural and Physical Science Professionals	Agricultural and Forestry Scientists	7.6%	483	6393
Machinery Operators and Drivers	Machine Operators	Paper and Wood Processing Machine Operators	6.9%	521	7581
Technicians and Trades Workers	Miscellaneous Technicians and Trades Workers	Gallery, Library and Museum Technicians	6.4%	431	6760
Machinery Operators and Drivers	Machine Operators	Textile and Footwear Production Machine Operators	6.2%	315	5073
Machinery Operators and Drivers	Mobile Plant Operators	Agricultural, Forestry and Horticultural Plant Operators	6.1%	526	8597
Managers	Accommodation and Hospitality Managers	Other Accommodation and Hospitality Managers	5.7%	395	6925
Clerical and Administrative Workers	Call or Contact Centre Information Clerks	Call or Contact Centre Workers	5.4%	1155	21465
Labourers	Food Process Workers	Food and Drink Factory Workers	5.3%	1545	29352
Labourers	Food Process Workers	Meat, Poultry and Seafood Process Workers	5.1%	886	17239
Technicians and Trades Workers	Agricultural, Medical and Science Technicians	Agricultural Technicians	5.1%	114	2237
Managers	Chief Executives, General Managers and Legislators	Legislators	5.1%	95	1873
Professionals	Air and Marine Transport Professionals	Marine Transport Professionals	5.0%	354	7022
Professionals	Natural and Physical Science Professionals	Life Scientists	5.0%	258	5149
Labourers	Miscellaneous Labourers	Caretakers	5.0%	235	4718
Sales Workers	Sales Assistants and Salespersons	Service Station Attendants	4.8%	386	8109
Labourers	Food Preparation Assistants	Food Trades Assistants	4.4%	181	4151
Machinery Operators and Drivers	Stationary Plant Operators	Other Stationary Plant Operators	4.4%	690	15826
Community and Personal Service Workers	Personal Service and Travel Workers	Gallery, Museum and Tour Guides	4.2%	268	6316
Community and Personal Service Workers	Personal Carers and Assistants	Aged and Disabled Carers	4.2%	3233	77414
Labourers	Construction and Mining Labourers	Paving and Surfacing Labourers	4.2%	282	6793
Technicians and Trades Workers	Electronics and Telecommunications Trades Workers	Electrical Distribution Trades Workers	4.0%	284	7024
Technicians and Trades Workers	Miscellaneous Technicians and Trades Workers	Boat Builders and Shipwrights	4.0%	197	4974

Source: ABS cat 2068.0.

4.3 Innovation in the Tasmanian economy

Review of the Tasmanian industry structure showed larger and faster growing sectors in terms of output and employment, growth in occupation types and qualifications, and those sectors exhibiting higher productivity and revealed capabilities. In this section we overview the broad innovation profile across the Tasmanian industry structure. Do innovation indicators reveal characteristics intuitive to salient output, employment and workforce characteristics? The intention is not to analyse the links between industry innovation performance and macro-economic change, moreover to review some basic industry innovation characteristics and consider how they sit against the broader economic picture, with a view to informing such analyses in future papers.

4.3.1 Background on innovation, employment and skills

As discussed earlier, it is widely accepted that innovation is essential for competitiveness, productivity and growth in value-added. The relationship between innovation, skills and employment, however, is subject to significantly more ambiguity and debate in the literature (Pianta, 2005; Tether &. Mina et al, 2005). A general theme that does share some level of consensus is that process innovation is often associated with decreases in employment (the notion of machines displacing manual labour) while product innovation is associated with increased sales and employment. 'Innovation skill bias' is another key theme, where innovation is thought to generate demand for higher skilled employment at the expense of lower skilled employment (Toner, 2006; Tether & Mina et al, 2005). Though we consider these themes in discussion of the following innovation indicators, we don't seek to verify respective scholarly arguments in any detail here. The main aim is to present a first cut of innovation indicators across industry, that can be viewed alongside the economic profile presented in order to inform a more sophisticated exploration of connections between economic and innovation indicators.

4.3.2 Innovation status and type across Tasmanian industries

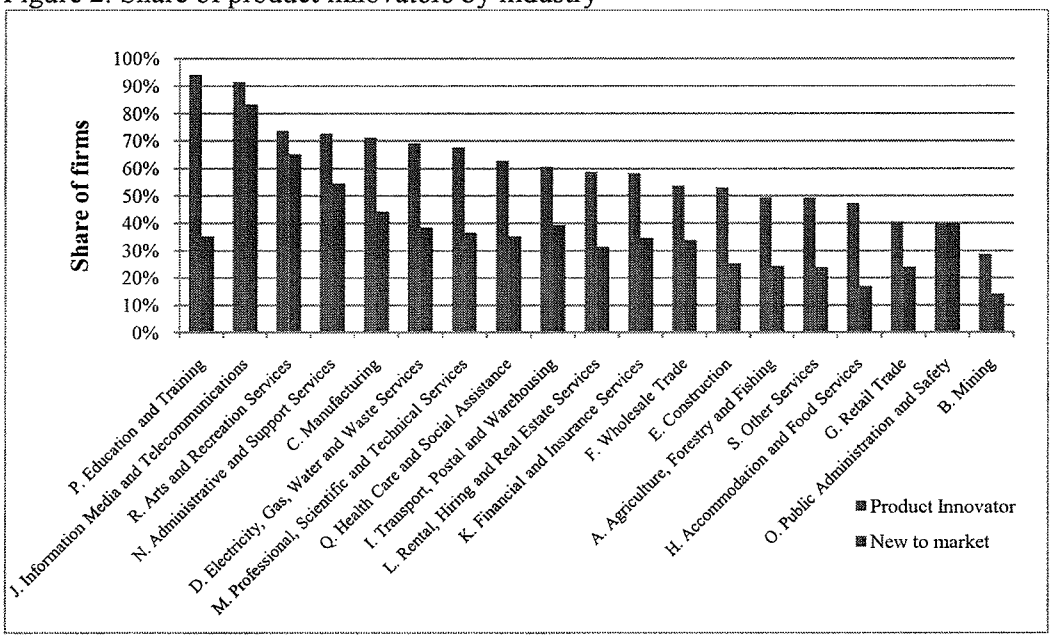
Table 15. Innovation status by industry.

Industry	Number of Innovation active firms	Number of responding firms	Share of Innovation active firms (%)	Share of non innovation-active firms
P. Education and Training	17	17	100.0%	0.0%
J. Information Media and Telecommunications	11	12	91.7%	8.3%
Q. Health Care and Social Assistance	45	51	88.2%	11.8%
D. Electricity, Gas, Water and Waste Services	11	13	84.6%	15.4%
M. Professional, Scientific and Technical Services	138	167	82.6%	17.4%
N. Administrative and Support Services	27	33	81.8%	18.2%
C. Manufacturing	254	316	80.4%	19.6%
R. Arts and Recreation Services	18	23	78.3%	21.7%
A. Agriculture, Forestry and Fishing	81	107	75.7%	24.3%
I. Transport, Postal and Warehousing	45	61	73.8%	26.2%
K. Financial and Insurance Services	40	55	72.7%	27.3%
L. Rental, Hiring and Real Estate Services	35	51	68.6%	31.4%
F. Wholesale Trade	79	121	65.3%	34.7%
B. Mining	9	14	64.3%	35.7%
E. Construction	82	134	61.2%	38.8%
S. Other Services	40	71	56.3%	43.7%
G. Retail Trade	115	212	54.2%	45.8%
H. Accommodation and Food Services	63	123	51.2%	48.8%
O. Public Administration and Safety	5	10	50.0%	50.0%
Total	**1,115**	**1591**	**70.1%**	**29.9%**

Table 15 shows a high average rate of innovation across all industries in Tasmania (70.1% of firms) and a low level of variation across sectors: more than half of all industries have higher than average shares of innovative firms[27]. Though the pervasive nature of innovation makes it difficult to differentiate between industries based on this indicator, we can single out the top four industries (in terms of the share of innovative firms) which are education and training, information, media and telecommunications, healthcare and social assistance, and electricity, gas and water. Figure 2 ranks industries by the share of product innovators.

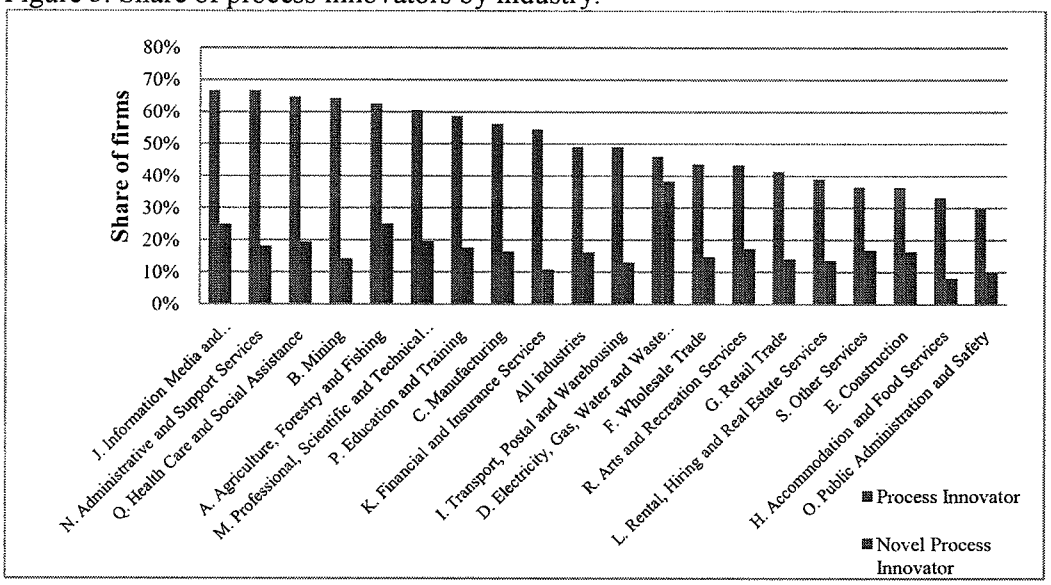
[27] An innovation active firm here is defined as any firm that introduced a new or significantly improved product or process in the TIC reference period 2004-2006.

Figure 2. Share of product innovators by industry



The average share of firms with product innovation across sectors is also relatively high at 58%, and again with a fairly low level of sectoral variation. Sectors showing the highest shares of both *new to enterprise* products and *new to market* products include education and training, information, media and telecommunications, arts and recreation services, administrative and support services and manufacturing. Three from five of these industries showed decreasing levels of employment in Table 4 (on page 8). Although caution needs to be exercised in relating figures, at face value, in a broader sense there does not appear an obvious association between product innovation and increases in employment at industry level. Again high overall levels of product innovation make it difficult to clearly differentiate industries and firm level analysis is warranted here. Figure 3 shows the sectoral distribution of process innovation.

Figure 3. Share of process innovators by industry.



The average share of process innovators is also reasonably high, and with a relatively low level of variation in shares of both new to firm and new to industry process innovators across sectors. Around half of all industries have above average shares of new to firm process innovators and half have above average shares of new to industry process innovators.

Four of the six top ranked industries by highest productivity increases in the ten years to 2006 (shown in Table 5) also have relatively higher shares of both new to firm and new to market process innovators (they feature in the top six ranked by respective shares in Figure 3): information media and telecommunications, agriculture, forestry and fishing, professional, scientific and technical services, and administrative support services[28]. This may indicate productivity improvements deriving from process innovations, though examples contrary to this theme implicate a need for deeper sector by sector analysis: electricity, gas, water and waste services shows the highest share of novel process innovators though the greatest decrease in productivity (though experienced a rapid increase in employment over the period), and mining has a relatively higher share of new to firm process innovators though the second largest decrease in productivity. There are many potential factors at play behind differences in respective data here of course, which may include differences in data collection methodologies and reference periods, issues with the measures themselves, and various other economic factors. The main point is that a more sophisticated model for sectoral analysis is required to further explain mechanics of the relationship between process innovation and productivity at the industry level, as some broad patterns in the data are consistent with themes in the literature, while others are not.

4.3.4 Sales from Innovation across industry

The share of sales attributable to innovative products provides an indication of the economic impact of innovation on the firm, and is indicative of the level of change

[28]Based on industry rankings in Figure 3 these sectors rank in the top six industries.

required in product mixes of firms in order to remain competitive. Firms were asked to estimate the share of sales attributable to changed products, and firm level data is aggregated to provide an indicator at industry level below. Table 16 shows the share of total industry turnover deriving from products that are new to enterprise, new to market and from all altered products (that includes sales from both categories as well as from incrementally improved products).

Table 16. Innovation sales by industry. 2006.

ANZSIC 2006 Division	Share of turnover accounted for by all altered products	Share of turnover accounted for by products new to market	Share of turnover accounted for by products new to enterprise
J. Information Media and Telecommunications	38.5%	15.4%	7.7%
O. Public Administration and Safety	26.6%	5.3%	0.4%
R. Arts and Recreation Services	24.5%	18.3%	3.1%
K. Financial and Insurance Services	22.6%	0.1%	9.7%
P. Education and Training	22.2%	2.4%	4.4%
M. Professional, Scientific and Technical Services	21.8%	3.4%	8.3%
C. Manufacturing	20.1%	9.7%	2.7%
E. Construction	17.8%	3.1%	5.2%
G. Retail Trade	14.9%	4.4%	4.3%
L. Rental, Hiring and Real Estate Services	14.4%	3.0%	2.7%
N. Administrative and Support Services	12.6%	2.9%	3.2%
H. Accommodation and Food Services	11.7%	2.0%	4.1%
A. Agriculture, Forestry and Fishing	11.3%	2.5%	2.9%
I. Transport, Postal and Warehousing	7.7%	2.0%	1.9%
B. Mining	7.3%	0.7%	0.0%
D. Electricity, Gas, Water and Waste Services	7.1%	2.8%	1.5%
Q. Health Care and Social Assistance	6.7%	3.2%	1.5%
F. Wholesale Trade	6.6%	2.0%	2.3%
S. Other Services	4.4%	0.9%	1.2%
All Industries	**15.7%**	**4.9%**	**3.9%**

All altered products account for the greatest share of industry turnover for information, media, and telecommunications. This is no surprise considering the rapid rate of advance in ICT related technologies, products, and processes – constant change is characteristic of survival in this sector and reflected in the statistics above.

Industries that generated greater than average shares of turnover from new to market products include arts and recreation services, information media and telecommunications, manufacturing and public administration and safety. This may be reflective of market conditions and competitive pressures in these industries and the need for ongoing novelty in technological innovations to remain competitive.

Industries generating a higher than average share of turnover from products new to enterprise were financial and insurance services, professional, scientific and technical services, information media and telecommunications, construction, education and training, retail trade, and accommodation and food services, implicating the

importance of adoption and adaption of new knowledge and products in these sectors and their role as intermediaries in diffusing externally generated innovations across the economy.

One point of note from the above discussion relates to the difficulty in making observations based on the disparate descriptive data sources presented in this paper, which indicates the need for sophisticated analytical tools to do so in a meaningful way. Nevertheless, in Figure 4 we combine respective indicators in a radar chart to view how innovation and economic indicators fit together for select industries.

Figure 4. Economic and innovation indicators.

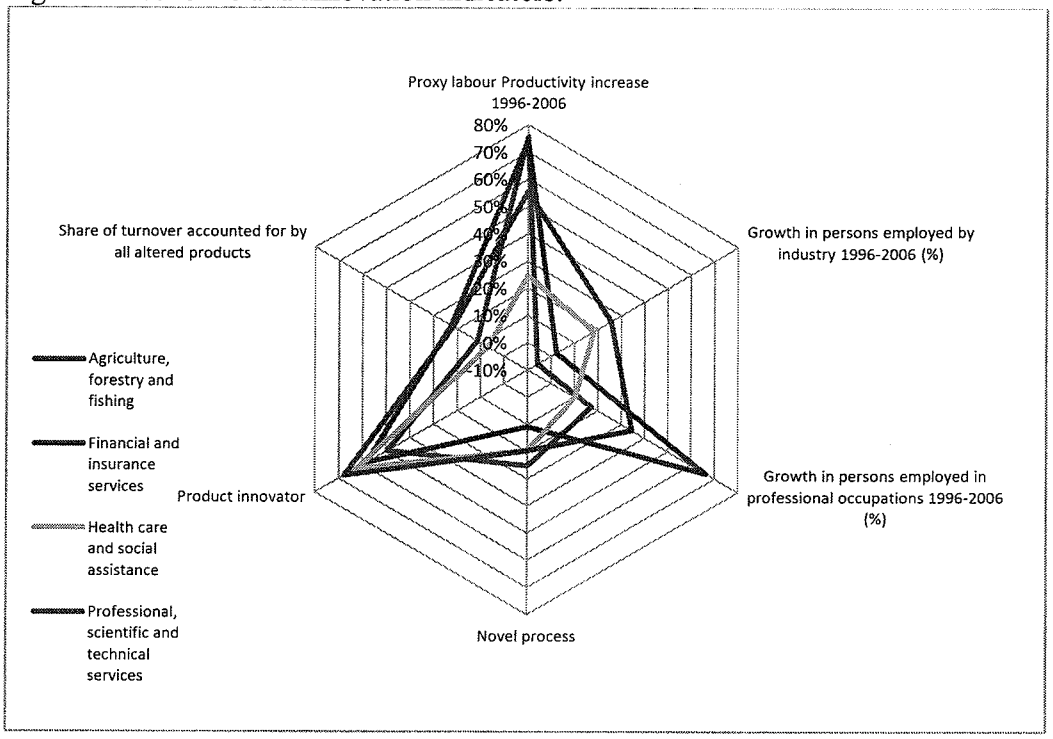


Figure 4 shows some interesting patterns for the selected industries in terms of relative industry rankings across indicators. The industry ranking based on the share of turnover from altered products is the same as that based on the growth rate in professional occupations (ie the industry with the highest share of turnover from altered products also showed the highest growth in professional occupations). In the same way, the industry ranking based on the share of product innovators is the same as the ranking based on industry growth in persons employed. The indicators appear to increase monotonically, in a way that seems consistent with themes in the literature regarding product innovation and employment growth, and innovation and skills bias. Industry rankings for novel process innovation and productivity increases are not so intuitive. This does indicate the need for modelling of these relationships, and although caution should be urged when viewing Figure 4, it does provide another means of indentifying patterns across disparate sets of indicators.

4.3.5 Innovation investment in Tasmanian industries

Table 17. Innovation investment, Tasmania and Australia.

Category of innovation expenditure	Proportion of total expenditures on innovation 2004-2006 Tasmania	Category of innovation expenditure	Proportion of total expenditures on innovation 2001-2003 Australia -
Advanced machinery, equipment or software	**60.2%**	Acquisition of machinery and equipment	**18.4%**
R&D	**20.8%**	Research and experimental Development	**30.7%**
Internal or external training	**5.6%**	Training	**1.5%**
Design activities	4.0%	Substantial new design work	3.9%
Activities for market preparation and introduction	**3.9%**	Market related expenditure aimed at market introduction	**7.9%**
Acquisition of external knowledge	3.2%	Acquisition of licenses, patents and other intellectual property	2.1%
Acquisition of R&D	2.3%	-	-
	100%	Other	**12.6%**
		Expenditure relates to the introduction of new or significantly improved processes	15.9%
		Expenditure relates to the introduction of new or significantly improved organisational/managerial processes	7.1%
			100%

What innovation activities are important for Tasmanian firms and how do they invest in innovation? Table 17 shows the distribution of total innovation investment across different activities for Tasmania and Australia[29]. Viewed against distributions of national investment, the most noticeable difference above is the greater share of investment in equipment and machinery for innovation in Tasmania at 60.2% of total innovation investment compared to 18.4% for Australia. Even assuming that expenditure in the additional categories for Australia include some spillover acquisition from the TIC categories, a marked difference remains[30]. For similar expenditure categories, the share of R&D expenditure in innovation investment in Tasmania is lower than for Australia by 10 percentage points, while investment on training related to innovation is relatively higher in Tasmania, and expenditure on marketing for innovations relatively lower, though accurate comparisons are not

[29] The proportions in Table 17 are derived from two different sources, the TIC and ABS Cat 8158.0 2003. As seen in Table 17, categories of expenditure measured are slightly different for the ABS survey and include three additional expenditure categories, though the other categories are similar. There may be some overlap from missing expenditure categories for Australia that might impact on comparability of national shares and caution should be exercised for comparisons, though figures above do provide some indication of differences in state and national expenditure distributions.

[30] Adding shares of the bottom three categories for Australia the total share is 54%, though there are various other methodological differences that may account for differences above.

possible due to differences in expenditure categories. Table 18 shows the distribution of innovation investment across industries in Tasmania.

Table 18. Innovation investment across Tasmanian industry.

ANZSIC 2006 Division	Industry expenditure on innovation as % of total innovation expenditure	Industry expenditure on machinery, equipment or software as % of total expenditure on machinery, equipment or software	Industry expenditure on R&D as % of industry innovation Expenditure	Industry expenditure on R&D as % of total R&D expenditure	Industry expenditure on innovation as % of industry turnover
C. Manufacturing	26.9%	24.7%	29.6%	38.2%	3.5%
D. Electricity, Gas, Water and Waste Services	22.8%	30.4%	3.2%	3.5%	17.4%
A. Agriculture, Forestry and Fishing	9.3%	9.7%	15.9%	7.1%	6.0%
M. Professional, Scientific and Technical Services	6.5%	1.9%	49.2%	15.3%	7.2%
I. Transport, Postal and Warehousing	5.6%	7.5%	5.6%	1.5%	5.3%
R. Arts and Recreation Services	4.9%	5.3%	28.7%	6.7%	5.3%
B. Mining	3.7%	3.2%	28.5%	5.0%	2.7%
E. Construction	3.6%	4.0%	15.5%	2.7%	3.9%
F. Wholesale Trade	3.5%	3.4%	25.7%	4.3%	1.2%
L. Rental, Hiring and Real Estate Services	2.5%	2.8%	11.2%	1.4%	9.2%
G. Retail Trade	2.5%	1.5%	21.1%	2.6%	0.9%
K. Financial and Insurance Services	2.0%	0.7%	39.3%	3.8%	0.5%
Q. Health Care and Social Assistance	2.0%	2.3%	14.4%	1.4%	4.5%
H. Accommodation and Food Services	1.6%	1.3%	24.9%	2.0%	3.5%
N. Administrative and Support Services	1.0%	0.6%	45.2%	2.2%	2.4%
S. Other Services	0.7%	0.4%	23.8%	0.8%	3.6%
J. Information Media and Telecommunications	0.3%	0.1%	32.3%	0.5%	2.2%
O. Public Administration and Safety	0.3%	0.0%	63.8%	0.8%	5.8%
P. Education and Training	0.3%	0.1%	30.4%	0.4%	7.4%
Total	100.0%	100.0%	20.8%	100.0%	3.7%

Table 18 shows a number of indicators related to industry innovation activities and investments. These show both industry contributions to total amounts invested across the Tasmanian economy (which are evidently influenced by sector size) and distributional shares within industries. These indicators may be relevant to skills input requirements for particular types of innovation activity and investment, and industries investing more in innovation are of interest as sources of future growth should those investments generate returns.

Industries accounting for relatively higher shares of total innovation investment include manufacturing (26.9%), electricity, gas, water and waste services (22.8%), agriculture, forestry and fishing (9.3%), professional, scientific and technical services (6.5%), transport, postal and warehousing (5.6%), and arts and recreation services (4.9%). As could be expected, these sectors also account for the majority of

investment in capital equipment for innovation, which is by far the largest component of total innovation expenditure.

In terms of R&D activity, manufacturing accounts for 38.2% of the total investment in Tasmania, followed by professional, scientific and technical services with 15.3%, agriculture, forestry and fishing with 7.1% and arts and recreation services with 6.7%. Despite R&D accounting for a comparatively lower share of innovation investment at the state than national level, R&D as a share of total innovation expenditure is relatively high across industries. Manufacturing is the traditional locus of R&D activities in the advanced economies, and this is the case in Tasmania. Within manufacturing, four industry subsectors account for over half of the total manufacturing investment in R&D: primary metal and metal product manufacturing (20%), basic chemical and chemical product manufacturing (14%), pulp, paper and converted paper product manufacturing (12%) and food product manufacturing (10%)[31]. As a proxy indicator for future potential growth in the Tasmanian economy, levels of R&D investment reiterate the importance of forestry, minerals and electricity and food related sectors identified in the Tasmanian innovation strategy.

Figure 5. Distribution of innovation investment within Tasmanian industries.

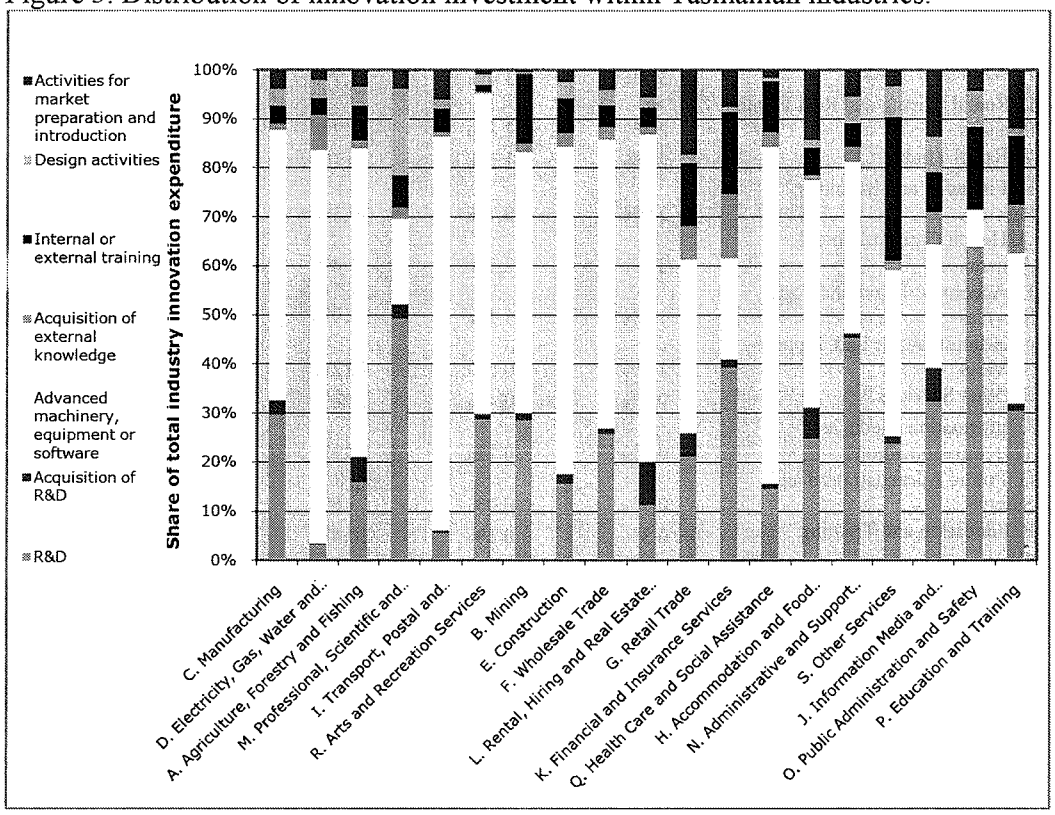


Figure 5 shows the distribution of investment *within* industry sectors. There is a high variation in the activities of importance across sectors, which may be useful to review in light of skilled occupation profiles, though capital and R&D absorb the largest shares across all in general. It important to note here that TIC data only includes firms

[31] See Smith & O'Brien (2008) for additional figures.

in the private sector economy, where as data presented in section one includes both public and private sector, so comparisons need to be made with caution.

5 Conclusion

This working paper sought to develop a broad, descriptive picture of the Tasmanian industrial structure, mapping key characteristics in terms of output, employment, occupation, qualification, productivity and innovation, as indicators of potential for future growth.

We showed that the public sector is relatively larger in Tasmania than Australia overall, and has been a major source of growth in output and employment over the past decade, with the health sector making the largest contributions in this regard.

Compared to Australia, manufacturing and agriculture are also larger sectors in terms of output and employment and are major contributors to exports. As is the case with many OECD economies and for Australia, manufacturing in Tasmania has decreased in output and employment over the past 10 to 20 years (though still accounts for the third largest industry share of total employment). Agriculture has shown the fastest average growth and the second highest level of productivity of all sectors over the past decade, though an ageing workforce may present a more severe future constraint for this sector.

Importantly, knowledge intensive business services have exhibited faster growth in output and employment, and substantially higher levels of productivity compared to other sectors.

With the growing services share in the Tasmanian economy, there is also an increase in higher skill professional occupations across the state, many of which are clustered in health and education sectors. Professional, scientific and technical services is also a key sector for growth in highly skilled, highly qualified occupations, with legal and accounting services, and architectural, engineering and technical services the source of over half of total employment in this sector. The electricity supply sector has been a significant contributor to total employment growth and particularly in higher skilled, tertiary qualified professional occupations.

As a cyclical sector construction is subject to more volatility though is a key source of total employment growth in manager and technician and trade worker occupations.

As detailed in the Tasmanian innovation Strategy, Tasmania's specialisation and deeper capabilities are particularly evident in aquaculture, forestry, and agriculture, and Tasmania has disproportionate shares in related occupations, though many of these are lower skill labourer level positions.

The pervasive nature of innovation across industries sectors in Tasmania makes it difficult to differentiate between more and less innovative sectors based on basic innovation indicators for status and type of innovation. This also makes it difficult to detect at face value any broader patterns in innovation characteristics and changes across the industrial structure at the industry level, though the sectors with identified

deeper capability are also the locus for investment in innovation in Tasmania: manufacturing, electricity, gas, water and waste services and agriculture, forestry and fishing are the top three contributors to total innovation investment, accounting for around half of the total investment in R&D, investment in machinery and equipment, and over half of total innovation investment overall.

Further study is suggested to model for the connection between the nature of innovation in industry and the link to broader changes across the industrial structure using aggregate measures. In particular there is a need for more sophisticated measures of innovation intensity in relation to industry performance and growth.

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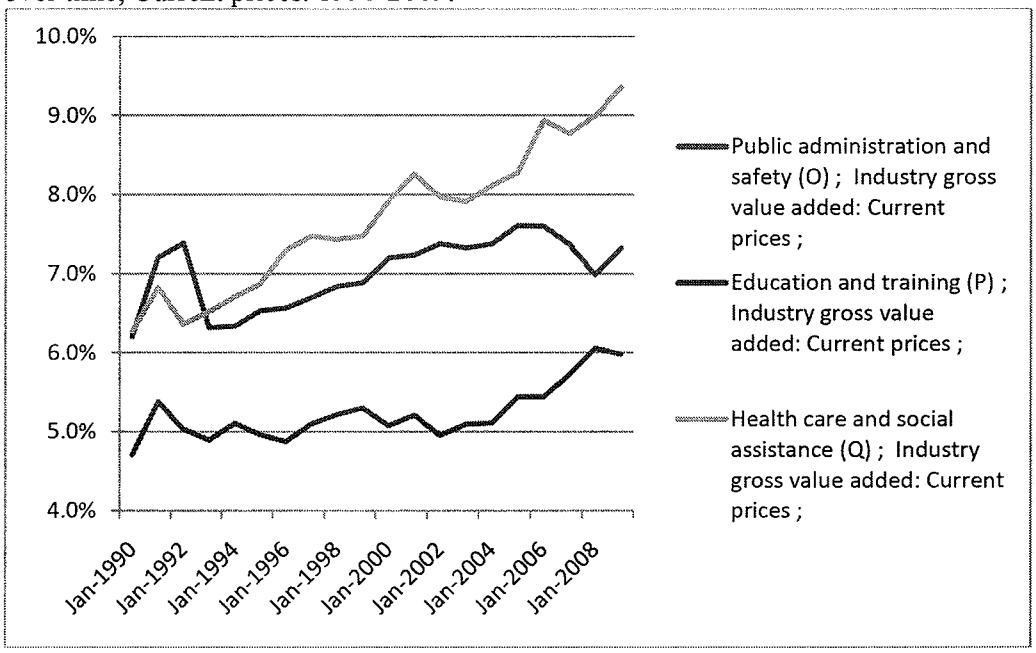
7 Appendices

Appendix A: ANZSIC divisions -relative shares in GVA over time

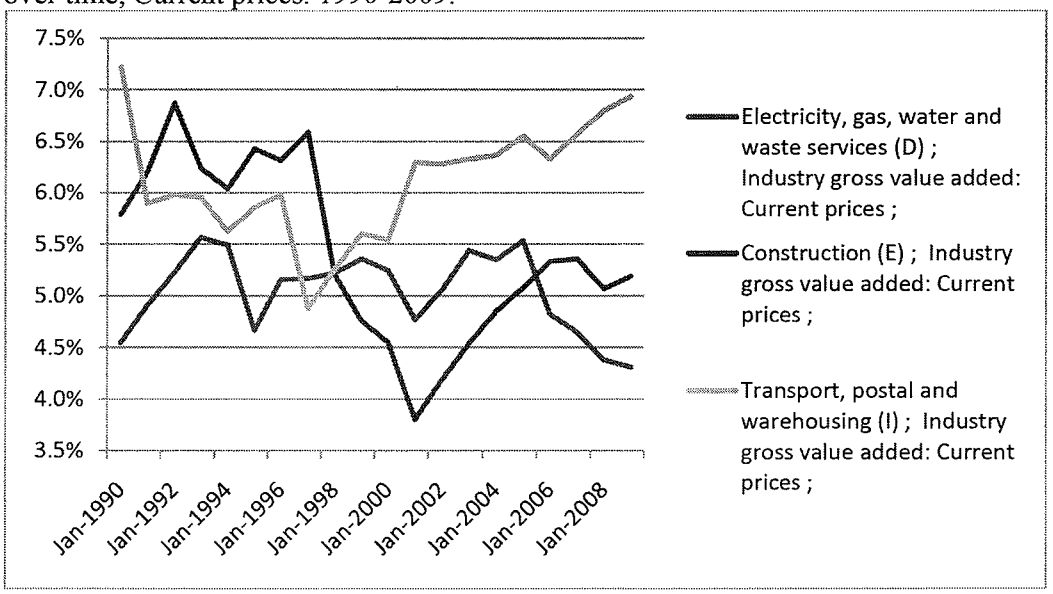
Public administration and safety, health and education

Tasmanian industrial structure: relative contribution of industry sectors to total GVA over time, Current prices. 1990-2009.



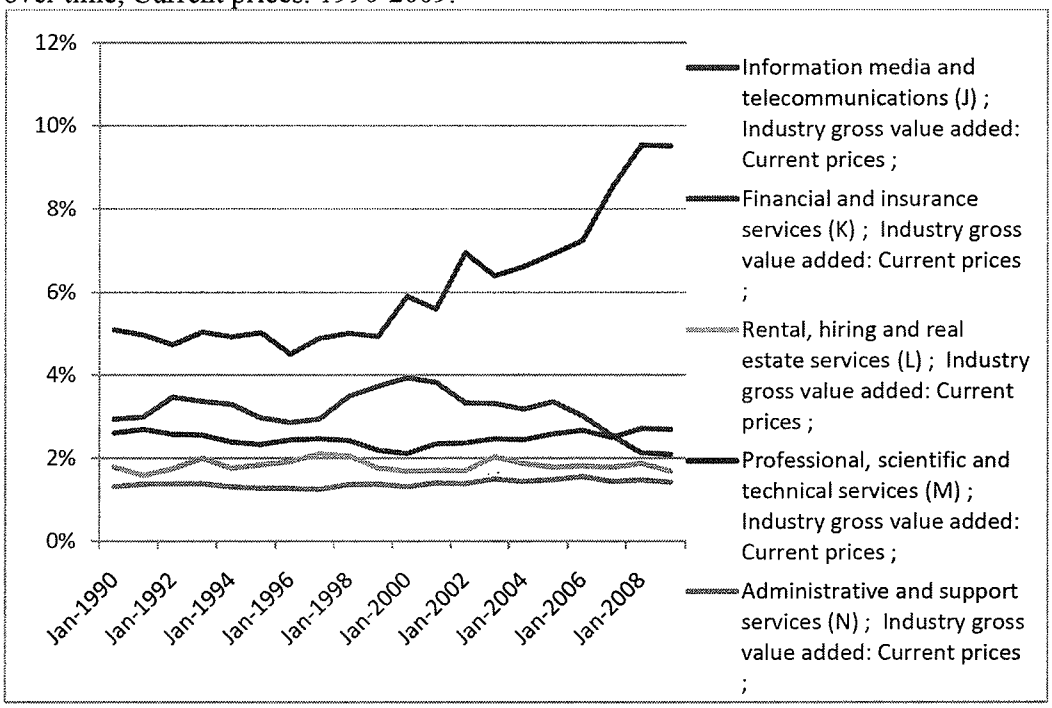
Utilities, construction and transport

Tasmanian industrial structure: relative contribution of industry sectors to total GVA over time, Current prices. 1990-2009.



Knowledge intensive business services

Tasmanian industrial structure: relative contribution of industry sectors to total GVA over time, Current prices. 1990-2009.



Appendix B – Distribution of exports by ANZSIC division, top contributors based on TIC data.

Distribution of total sales to overseas markets by industry,2006.

Industry sector	Share in total sales to overseas markets	Cumulative share of total sales to overseas markets
Manufacturing	76.4%	76.4%
Agriculture, forestry and fishing	8.9%	85.2%
Mining	5.0%	90.2%
Arts and recreation services	4.6%	94.8%

Source: Tasmanian innovation census data.

Distribution of total sales to mainland markets by industry,2006.

Industry sector	Share in total sales to mainland markets	Cumulative share of total sales to mainland markets
Manufacturing	42.8%	42.8%
Financial and insurance services	11.3%	54.1%
Agriculture, forestry and fishing	8.8%	62.9%
Transport, postal and warehousing	8.7%	71.6%
Mining	6.9%	78.5%
Wholesale trade	5.3%	83.7%
Professional, scientific and technical services	4.3%	88.0%
Arts and recreation services	3.6%	91.7%

Source: Tasmanian innovation census data.

Appendix C: Industry employment shares by subsector, Tasmania and Australia

Industry sector		Persons employed Tasmania	Persons employed Australia	Tasmanian industry share of total national industry employment	Industry share in total employment - Tasmania	Industry share in total employment - Australia
A. Agriculture, Forestry and Fishing						
	02 Aquaculture	863	3028	28.5%	8.2%	1.2%
	03 Forestry and Logging	1519	6721	22.6%	14.5%	2.6%
	04 Fishing, Hunting and Trapping	404	3447	11.7%	3.9%	1.3%
	05 Agriculture, Forestry and Fishing Support Services	645	15338	4.2%	6.1%	5.9%
	01 Agriculture	7061	230284	3.1%	67.3%	89.0%
	Total	10492	258818	4.1%	100.0%	100.0%
C. Manufacturing						
	11 Food Product Manufacturing	5369	152958	3.5%	28.2%	18.8%
	21 Primary Metal and Metal Product Manufacturing	2130	71781	3.0%	11.2%	8.8%
	14 Wood Product Manufacturing	2076	42455	4.9%	10.9%	5.2%
	24 Machinery and Equipment Manufacturing	1477	92462	1.6%	7.8%	11.4%
	23 Transport Equipment Manufacturing	1153	89960	1.3%	6.1%	11.1%
	15 Pulp, Paper and Converted Paper Product Manufacturing	970	21334	4.5%	5.1%	2.6%
M. Professional, Scientific and Technical Services						
69 Professional, Scientific and Technical Services (except Computer System Design and Related Services)	693 Legal and Accounting Services	2825	185395	35.5%	32.1%	31.6%
	692 Architectural, Engineering and Technical Services	2179	131643	27.4%	24.8%	22.4%
	696 Management and Related Consulting Services	790	58619	9.9%	9.0%	10.0%
	691 Scientific Research Services	776	25400	9.8%	8.8%	4.3%
D. Electricity, Gas, Water and Waste Services						
26 Electricity Supply	2630 Electricity Distribution	1055	24181	4.4%	38.6%	31.3%
	2612 Hydro-Electricity Generation	745	1535	48.5%	27.2%	2.0%
	2620 Electricity Transmission	185	2242	8.3%	6.8%	2.9%
I. Transport, Postal and Warehousing						
	46 Road Transport	4728	204083	2.3%	53.4%	50.2%
	48 Water Transport	562	4218	13.3%	6.3%	1.0%
	52 Transport Support Services	1186	48428	2.4%	13.4%	11.9%
	521 Water Transport Support Services	544	12799	4.3%	6.1%	3.1%

Appendix D: Industry contributions to growth in occupations

Sectoral contribution to growth in employment by occupation, 1996-2006.
Managers

Industry (ANZSIC06)	1996	2006	Growth in numbers	Percentage growth
Construction	1460	2,071	611	45.3%
Retail Trade	3851	4,297	446	33.0%
Public Administration and Safety	1482	1,812	330	24.4%
Electricity, Gas, Water and Waste Services	81	403	322	23.9%
Manufacturing	1996	2,223	227	16.8%
Education and Training	925	1,081	156	11.6%
Professional, Scientific and Technical Services	573	705	132	9.8%
Administrative and Support Services	276	387	111	8.2%
Accommodation and Food Services	2454	2,524	70	5.2%
Arts and Recreation Services	351	401	50	3.7%
Transport Postal and Warehousing	753	790	37	2.7%
Rental, Hiring and Real Estate Services	289	326	37	2.7%
Health Care and Social Assistance	882	880	-2	-0.1%
Mining	134	122	-12	-0.9%
Information Media and Telecommunications	308	289	-19	-1.4%
Financial and Insurance Services	756	657	-99	-7.3%
Wholesale Trade	1267	1,111	-156	-11.6%
Other Services	664	486	-178	-13.2%
Agriculture, Foresty and Fishing	5724	5,337	-387	-28.7%
Inadequately described/Not stated	715	389	-326	-24.1%
Total	24941	**26,291**	1,350	100.0%

Sectoral contribution to growth in employment by occupation, 1996-2006.
Professionals

Industry (ANZSIC06)	1996	2006	Growth in numbers	Percentage growth
Public Administration and Safety	3147	4,578	1,431	24.1%
Education and Training	8853	10,243	1,390	23.4%
Professional, Scientific and Technical Services	3150	4,240	1,090	18.3%
Health Care and Social Assistance	7171	7,903	732	12.3%
Electricity, Gas, Water and Waste Services	75	639	564	9.5%
Financial and Insurance Services	674	1,121	447	7.5%
Administrative and Support Services	277	674	397	6.7%
Retail Trade	562	688	126	2.1%
Agriculture, Forestry and Fishing	407	477	70	1.2%
Arts and Recreation Services	486	532	46	0.8%
Rental, Hiring and Real Estate Services	139	182	43	0.7%
Transport Postal and Warehousing	372	411	39	0.7%
Inadequately described/Not stated	405	410	5	0.1%
Construction	223	222	-1	0.0%
Mining	202	169	-33	-0.6%
Wholesale Trade	468	429	-39	-0.7%
Manufacturing	1263	1,215	-48	-0.8%
Other Services	686	628	-58	-1.0%
Accommodation and Food Services	228	145	-83	-1.4%
Information Media and Telecommunications	1160	985	-175	-2.9%
Total	29948	35,891	5,943	100.0%

Sectoral contribution to growth in employment by occupation, 1996-2006.
Technicians and trade workers

Industry (ANZSIC06)	1996	2006	Growth in numbers	Percentage growth
Construction	5461	6,956	1,495	110.7%
Electricity, Gas, Water and Waste Services	340	776	436	32.3%
Accommodation and Food Services	1357	1,766	409	30.3%
Administrative and Support Services	430	746	316	23.4%
Professional, Scientific and Technical Services	957	1,142	185	13.7%
Other Services	3396	3,560	164	12.1%
Health Care and Social Assistance	839	906	67	5.0%
Arts and Recreation Services	344	355	11	0.8%
Financial and Insurance Services	49	47	-2	-0.1%
Public Administration and Safety	1165	1,133	-32	-2.4%
Mining	428	380	-48	-3.6%
Transport Postal and Warehousing	494	438	-56	-4.1%
Rental, Hiring and Real Estate Services	192	125	-67	-5.0%
Manufacturing	6076	5,994	-82	-6.1%
Education and Training	888	803	-85	-6.3%
Retail Trade	1832	1,742	-90	-6.7%
Agriculture, Forestry and Fishing	690	595	-95	-7.0%
Wholesale Trade	1092	823	-269	-19.9%
Information Media and Telecommunications	1199	791	-408	-30.2%
Inadequately described/Not stated	967	879	-88	-6.5%
Total	28196	29,957	1,761	130.4%

Professional, Scientific and technical services: ANZSIC industry subdivision	Employment in Tas	Employment in Aus	Subsector share of total industry employment - Tas	Subsector share of total industry employment - Aus
691 Scientific Research Services	776	25400	8.8%	4.3%
692 Architectural, Engineering and Technical Services	2179	131643	24.8%	22.4%
693 Legal and Accounting Services	2825	185395	32.1%	31.6%
694 Advertising Services	304	27652	3.5%	4.7%
695 Market Research and Statistical Services	537	25355	6.1%	4.3%
696 Management and Related Consulting Services	790	58619	9.0%	10.0%
697 Veterinary Services	299	13452	3.4%	2.3%
699 Other Professional, Scientific and Technical Services	237	13589	2.7%	2.3%
700 Computer System Design and Related Services	853	106038	9.7%	18.1%
Total	8800	587143	100.0%	100.0%

Appendix E – Qualifications by occupation, 2006.

	Level of Education						
	Degree or more	Diploma & Advanced Diploma	Certificate III & IV	Certificate I & II	No post-school qualification	Total	Proportion of total workforce
Managers	19%	11%	23%	0%	47%	100%	13%
Professionals	68%	14%	6%	0%	12%	100%	18%
Technicians and Trades Workers	4%	6%	58%	0%	32%	100%	15%
Community and Personal Service Workers	9%	11%	24%	1%	54%	100%	10%
Clerical and Administrative Workers	10%	9%	16%	1%	65%	100%	14%
Sales Workers	4%	4%	12%	1%	79%	100%	10%
Machinery Operators and Drivers	1%	2%	21%	0%	76%	100%	7%
Labourers	2%	2%	14%	1%	82%	100%	12%
TOTAL	15%	8%	22%	1%	51%	100%	100%
2001 total	16%	7%	19%	3%	55%	100%	100%
Difference between 2001 and 2006	+2	+1	+3	-2	-4	-	-

Source data: ABS 2006 Census
Created by: Strategy Team, Skills Tasmania

ANZSIC 2006 Division and Subdivision Codes and Titles

A Agriculture, Forestry and Fishing

01 Agriculture
02 Aquaculture
03 Forestry and Logging
04 Fishing, Hunting and Trapping
05 Agriculture, Forestry and Fishing Support Services

B Mining

06 Coal Mining
07 Oil and Gas Extraction
08 Metal Ore Mining
09 Non-Metallic Mineral Mining and Quarrying
10 Exploration and Other Mining Support Services

C Manufacturing

11 Food Product Manufacturing
12 Beverage and Tobacco Product Manufacturing
13 Textile, Leather, Clothing and Footwear Manufacturing
14 Wood Product Manufacturing
15 Pulp, Paper and Converted Paper Product Manufacturing
16 Printing (including the Reproduction of Recorded Media)
17 Petroleum and Coal Product Manufacturing
18 Basic Chemical and Chemical Product Manufacturing
19 Polymer Product and Rubber Product Manufacturing
20 Non-Metallic Mineral Product Manufacturing

21 Primary Metal and Metal Product Manufacturing
22 Fabricated Metal Product Manufacturing
23 Transport Equipment Manufacturing
24 Machinery and Equipment Manufacturing
25 Furniture and Other Manufacturing

D Electricity, Gas, Water and Waste Services

26 Electricity Supply
27 Gas Supply
28 Water Supply, Sewerage and Drainage Services
29 Waste Collection, Treatment and Disposal Services

E Construction

30 Building Construction
31 Heavy and Civil Engineering Construction
32 Construction Services

F Wholesale Trade

33 Basic Material Wholesaling
34 Machinery and Equipment Wholesaling
35 Motor Vehicle and Motor Vehicle Parts Wholesaling
36 Grocery, Liquor and Tobacco Product Wholesaling
37 Other Goods Wholesaling
38 Commission-Based Wholesaling

G Retail Trade

39 Motor Vehicle and Motor Vehicle Parts Retailing
40 Fuel Retailing
41 Food Retailing
42 Other Store-Based Retailing
43 Non-Store Retailing and Retail Commission-Based Buying and/or Selling

H Accommodation and Food Services

44 Accommodation
45 Food and Beverage Services

I Transport, Postal and Warehousing

46 Road Transport
47 Rail Transport
48 Water Transport
49 Air and Space Transport
50 Other Transport
51 Postal and Courier Pick-up and Delivery Services
52 Transport Support Services
53 Warehousing and Storage Services

J Information Media and Telecommunications

54 Publishing (except Internet and Music Publishing)
55 Motion Picture and Sound Recording Activities
56 Broadcasting (except Internet)
57 Internet Publishing and Broadcasting
58 Telecommunications Services
59 Internet Service Providers, Web Search Portals and Data Processing Services
60 Library and Other Information Services

K Financial and Insurance Services

62 Finance
63 Insurance and Superannuation Funds
64 Auxiliary Finance and Insurance Services

L Rental, Hiring and Real Estate Services

66 Rental and Hiring Services (except Real Estate)
67 Property Operators and Real Estate Services

M Professional, Scientific and Technical Services

69 Professional, Scientific and Technical Services (Except Computer System Design and Related Services)
70 Computer System Design and Related Services

N Administrative and Support Services

72 Administrative Services
73 Building Cleaning, Pest Control and Other Support Services

O Public Administration and Safety

75 Public Administration
76 Defence
77 Public Order, Safety and Regulatory Services

P Education and Training

80 Preschool and School Education
81 Tertiary Education
82 Adult, Community and Other Education

Q Health Care and Social Assistance

84 Hospitals
85 Medical and Other Health Care Services
86 Residential Care Services
87 Social Assistance Services

R Arts and Recreation Services

89 Heritage Activities
90 Creative and Performing Arts Activities

91 Sports and Recreation Activities

92 Gambling Activities

S Other Services

94 Repair and Maintenance

95 Personal and Other Services

96 Private Households Employing Staff and Undifferentiated Goods- and Service-Producing Activities of Households for Own Use